



The Shirpur Education Society's

**R. C. Patel College of Engineering and
Polytechnic, Shirpur**

Department of Mechanical Engineering

NAME OF COURSE: - Power Engineering (PER)

CODE OF COURSE: - 315371

SEMESTER: - TYME-5K

SUBJECT TEACHER: - Mr. B. S. Patil

R. C. Patel College of Engineering and Polytechnic, Shirpur

QUESTION BANK

Chapter 2. Air Conditioning

Program Name: Mechanical Engineering

Name of Subject & Code : Power Engineering (315371)

Date -02/07/2026

Program Code: ME5k

Semester : Fifth

Q. NO.	QUESTION	DETAIL	MAPPING
1	List any four factors affecting comfort air conditioning.	W-25 2 M	TLO-2.1-R
2	Define dry bulb temperature and wet bulb temperature.	W-25 2 M	TLO-2.2-R
3	Represent the following processes on Psychrometric chart :- i) Sensible cooling ii) Humidification iii) Heating and dehumidification iv) Cooling and humidification.	W-25 4 M	TLO-2.3-U
4	Explain with a neat sketch construction and working of a 2/4-way ceiling-mounted cassette air conditioner.	W-25 4 M	TLO-2.4-A
5	With the help of a psychrometric chart, find the following properties of air at 30°C DBT and 70% relative humidity :- i) Dew point temperature ii) Wet bulb temperature iii) Specific volume of air iv) Enthalpy of air v) Specific humidity of air. Draw a psychrometric chart shown all the above properties.	W-25 6M	TLO-2.2-A
6	Air is supplied to a conditioned room at 17°C DBT and 50% RH. The supply volumetric flow rate is 0.8 m ³ /s. The air leaves the room at 25.0°C DBT, and during this process, the relative humidity decreases by 5%. Find :- i) Dew-point temperature of the supply air ii) Change in enthalpy and specific humidity during the process iii) Rate of sensible heat gain.	W-25 6M	TLO-2.3-A
7	Define Refrigeration and air conditioning system.	OTHER- 4M	TLO-2.1-R
8	Classify the air conditioning system.	OTHER- 4M	TLO-2.1-U
9	Write down the enthalpy of moist air.	OTHER- 4M	TLO-2.2-R
10	Plot the psychrometric chart and show the following processes on it : (i) Sensible heating (ii) Latent cooling (iii) Latent heating (iv) Sensible cooling (v) Heating with humidification (vi) Heating with dehumidification (vii) Cooling with dehumidification (viii) Cooling with humidification.	OTHER- 6M	TLO-2.3-U
11	Differentiate between window air conditioning and split air conditioning.	OTHER- 4M	TLO-2.4-A
12	Define Relative humidity and Specific humidity.	OTHER- 4M	TLO-2.2-R
13	Define dry air, moist air, saturated air, dew point temperature.	OTHER- 4M	TLO-2.2-R
14	Explain with a neat sketch construction and working of Construction and working of window air conditioner.	OTHER- 6M	TLO-2.4-A
15	Explain with a neat sketch construction and working of Construction and working of split air conditioner.	OTHER- 6M	TLO-2.4-A

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~~Air~~ 27/7/26



Unit - 02

Air Conditioning System.

Total Hrs = 12

Total Marks = 16

2.1 - Air conditioning

def:- It is a process of controlling & maintaining temperature, humidity, purity & air movement within an enclosed space.

Factors affecting comfort air conditioning

a) Temperature:- Air temperature should ideally fall between 21°C to 25°C .

b) Relative humidity:-

Air humidity should ideally fall between 40% to 60% to prevent the air from feeling too sticky or excessively dry.

c) Air movement:-

optical range is 0.15m/s to 0.25m/s . or
 0.5m/min to 8m/min

d) Air purity:-

Air must be filtered to remove dust, odors, & indoor pollutants.

e) Air quality:-

usually 15% of fresh air for any AC system is added to replenish the amount of O_2 in air & dilute CO_2 & remaining 85% of air re-circulated through space.

classification of air conditioning system:-

1] Based on major function or purpose.

- a] Comfort air conditioning:- Generally focuses on human health, comfort, & efficiency, eg Homes & offices.
- b] Industrial air conditioning:-

The purpose of this conditioning system is to maintain atmospheric conditions for manufacturing processes, laboratories & machinery.

2] Based on season of the year:-

- a] Summer Air conditioning system:-

Cooling & ~~dehumi~~ dehumidification of air is done.

- b] Winter air conditioning system:-

Heating & humidification of air is done.

- c] Year-round Air conditioning:-

- 1] Cooling & dehumidification of air in summer
- 2] Heating & humidification of air in winter.

3] Based on equipment arrangement:-

- a] unitary system:- single factory assembled unit used for small area or single room
- b] Central system:- Large scale system, used to

conditioning the more than one room for some temperature

4] Based on working substance:-

- a] All air system.
- b] chilled water system
- c] Air water system.

Difference between comfort air conditioning & Industrial air conditioning.

Comfort air conditioning	Industrial air conditioning
a] To provide pleasant & healthy environment for human beings.	a] To provide optimal environmental conditions for machinery, products & manufacturing process.
b] Comfort conditions are Temp = 21°C to 25°C Humidity = 50% RH air velocity = 5 m/min to 8 m/min	b] Conditioning depends on process, & machinery.
c] For example, offices, schools, homes etc.	c] Textile mills, paper manufacturing, server rooms, etc.

2.2 Psychrometry:-

Branch of science deals with study of moist air [dry air & moisture]

a) Dry air:-

air without moisture is known as dry air.

It is combination of Nitrogen, oxygen, CO_2 , etc.

It is generally a perfect gas & obeys the $PV = mRT$ - ideal gas equation

b) moist air:-

It is a mixture of dry air & moisture.

c) Saturated air:-

It is a moist air, when air has diffused the maximum amount of water vapours in it at given temperature & pressure.

d) Dry bulb Temperature [t_d or t_{db}]

It is a temperature of air recorded by a clean & dry sensing thermometer.

e) wet bulb temperature [t_w or t_{wb}].

It is a temperature of air recorded by thermometer when its bulb is covered with wetted cloth.

f] Wet bulb depression:-

It is difference between Dry bulb temperature & wet bulb temperature.

g] Dew point temperature:- $[t_{dp}]$

It is temperature of air recorded by ordinary thermometer, when the moisture present in air starts to condensed.

h] Dew point depression:-

It is difference between the dry bulb temp. & dew point temperature of air.

i] Specific humidity or humidity ratio $[w]$

It is a ratio of mass of water vapours to the mass of dry air in a given volume of moist air.

unit:- gm/kg of dry air or gm/m³ of dry air

$$\therefore w = \frac{m_v}{m_a} = \frac{\text{mass of water vapour}}{\text{mass of dry air.}}$$

$$= 0.622 \left[\frac{P_v}{P_b - P_v} \right] \text{ for unsaturated air}$$

P_v = partial pressure of water vapour in bar

P_b = barometric pressure = 1.01325 bar.

$$w = 0.622 \left[\frac{P_s}{P_b - P_s} \right] \text{ for saturated air}$$

P_s = partial pressure of water vapour of saturated air.

J] degree of saturation or Percentage humidity $[u]$:-

Ratio of mass of water vapour in a unit mass of dry air to the mass of water vapour in the same mass of dry air when it is saturated at the same temperature.

$$u = \frac{W}{W_s}$$

K] Relative Humidity $[\phi]$:-

Ratio of actual mass of water vapour $[m_v]$ in a given volume of moist air to the mass of water vapour $[m_s]$ in the same volume of saturated air at the same temperature & pressure.

$$\phi = \frac{m_v}{m_s} = \frac{P_v}{P_s}$$

L] Absolute Humidity:-

Weight of vapour in a unit volume of dry air.

M] Enthalpy of moist air $[H]$

It is a total heat ~~content~~ contained in moist air.

$$H = 1.022t_d + W [2500 + 1.8t_d]$$

or

$$H = 1.022t_d + W [L_{dp} - 2.3t_{dp}]$$

L_{dp} = Latent heat at dew point temperature

2.3 Psychrometric processes:-

- 1] sensible heating
- 2] sensible cooling
- 3] Humidification
- 4] Dehumidification
- 5] Heating & humidification
- 6] Heating & dehumidification
- 7] Cooling & de-humidification
- 8] cooling with adiabatic humidification.

1] sensible heating:-

The heating of air, without change in its ~~sp~~ specific humidity is known as sensible ~~heating~~ heating.

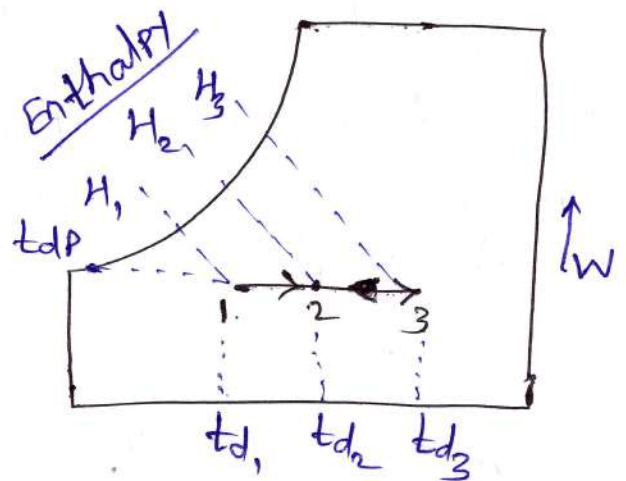
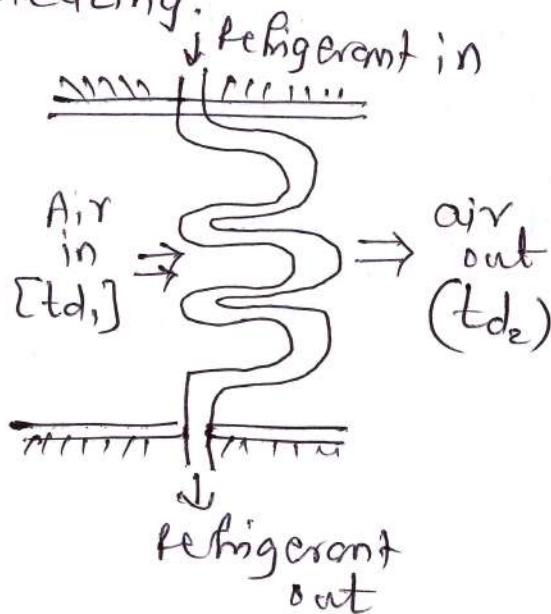


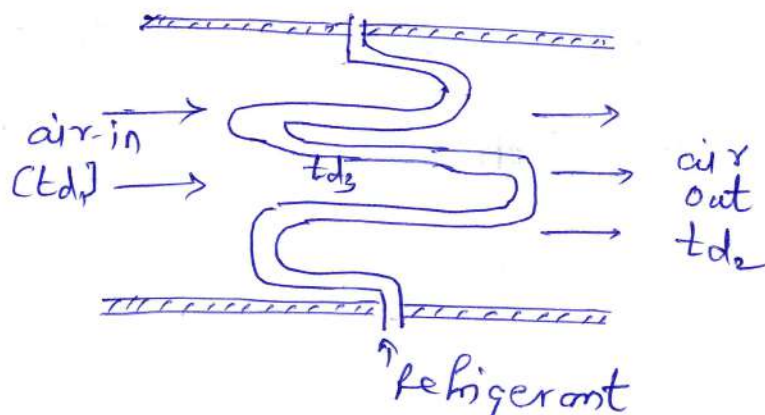
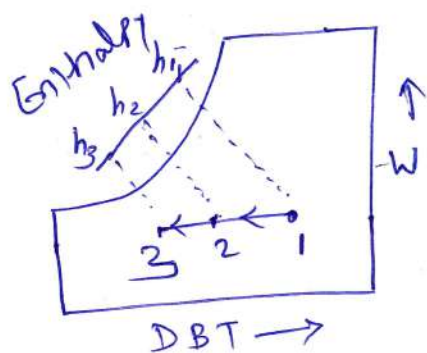
Fig. sensible heating.

$$\text{heat added} = h_1 - h_2$$

3]

Sensible cooling:-

Cooling of air without any change in its specific humidity is known as sensible cooling.

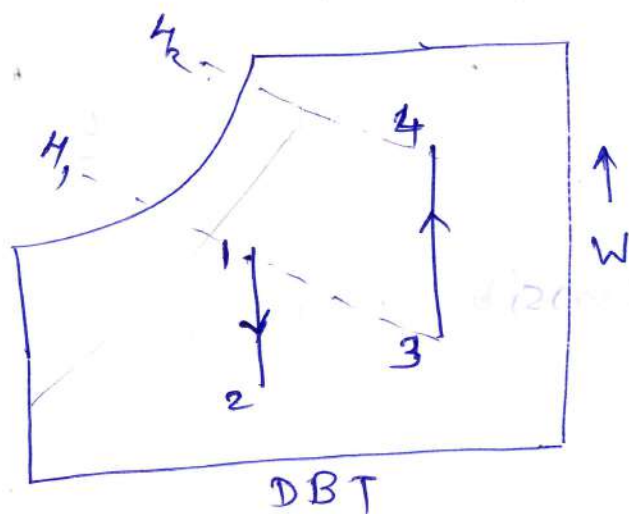


$$\text{Heat rejected} = h_1 - h_2$$

3] Humidification & dehumidification:-

Humidification or latent cooling is the process in which moisture is added in air without affecting its dry bulb temperature or keeping the DBT constant.

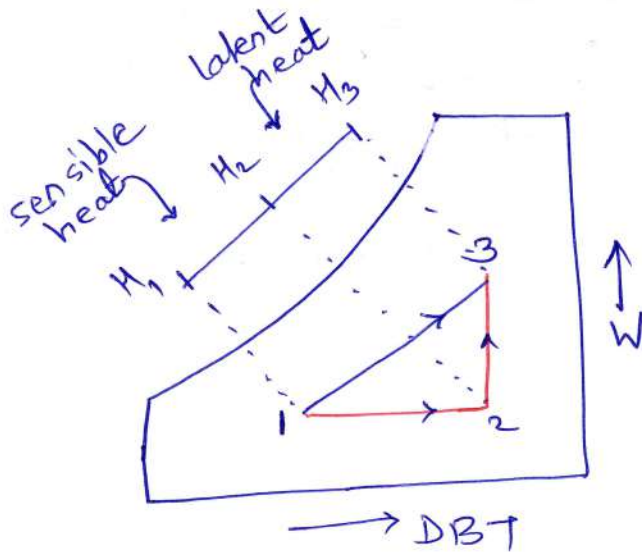
Dehumidification or latent heating is the process in which moisture or water vapour from air is removed keeping DBT constant.



Process = 1 → 2 = dehumidification

Process = 3 → 4 = humidification

5] Heating & Humidification

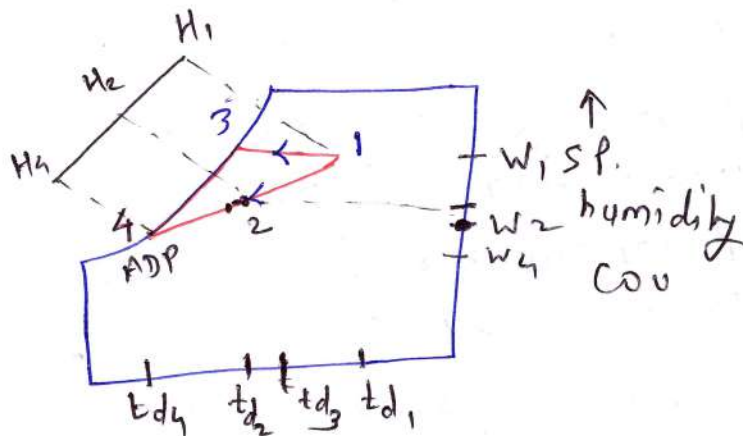


In this process the DBT & sp. humidity of air increases.

ie. air become warm & humid.

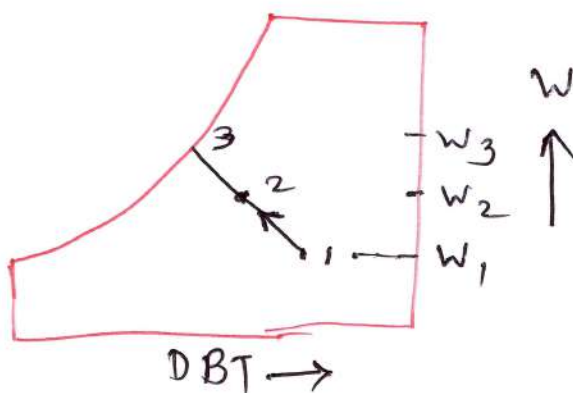
Heat added during the process is $(H_3 - H_1)$ which is equivalent to sensible heat $[h_2 - h_1]$ & latent heat $[H_3 - H_2]$

6] cooling with dehumidification:-



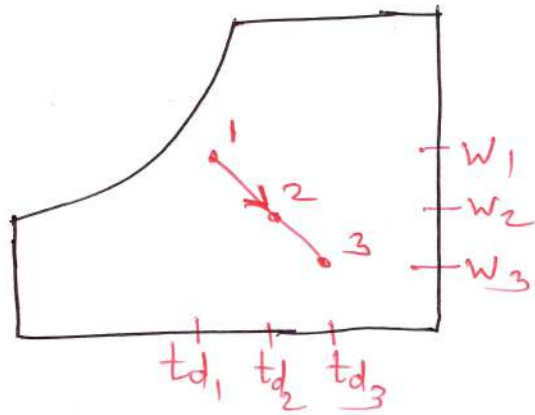
Cooling & dehumidification of the air is only possible if the air is cooled below the dew point temperature of the air. it is necessary to maintain the coil surface temperature below dew point temperature of air.

7] Cooling with adiabatic humidification:-



It is a process during which DBT of air decreases & sp. humidity of air increases.

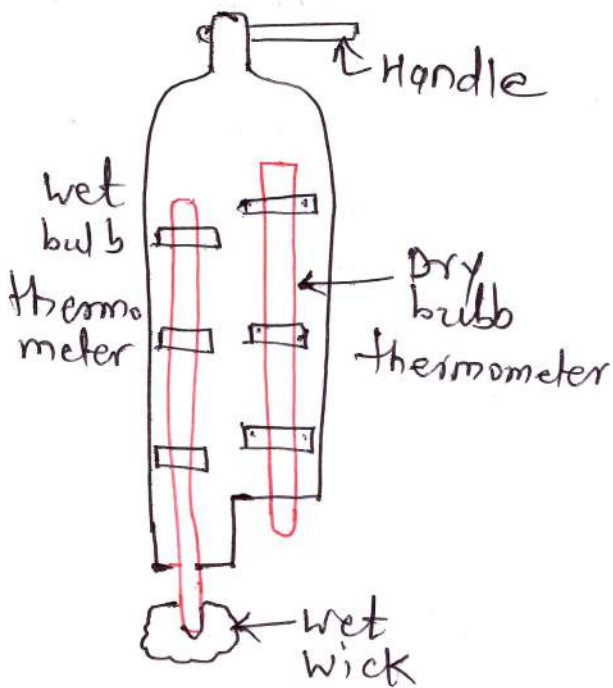
8] Heating & dehumidification:-



It is a process during which DBT of air increases & sp. humidity is decreases.

Sling Psychrometer:-

It consists of two mercury thermometer mounted on a frame which is provided with handle as shown in figure.



A handle of the frame used for rotating the psychrometer to produce necessary air motion. The recommended velocity of air is about 5 m/sec.

1] Expected room conditions are 20°C & $55\% \text{ RH}$.
 outdoor conditions are 39°C & $\text{RH } 70\%$. Locate
 both points on psychrometric chart & find how
 much Enthalpy per kg of air & moisture content
 per kg of dry air need to be changed to
 achieve room conditions. Draw skeleton of
 psychrometric chart & show points.

→ Locate point 1 room conditions at 20°C & $55\% \text{ RH}$
 on psychrometric chart.
 point 2 outdoor conditions at 39°C & $70\% \text{ RH}$

Find Enthalpy at inlet $H_1 = 40 \text{ kJ/kg}$

Enthalpy at outlet $H_2 = 117 \text{ kJ/kg}$

$W_1 = 0.0062 \text{ kJ/kg of dry air}$

$W_2 = 0.037 \text{ kJ/kg of dry air}$

1] change in Enthalpy $= H_1 - H_2$

$$= 117 - 40$$

$$= 77 \text{ kJ/kg of dry air}$$

2] moisture change $= W_1 - W_2$

$$= 0.0062 - 0.028$$

$$= 0.0218 \text{ kJ/kg of dry air}$$

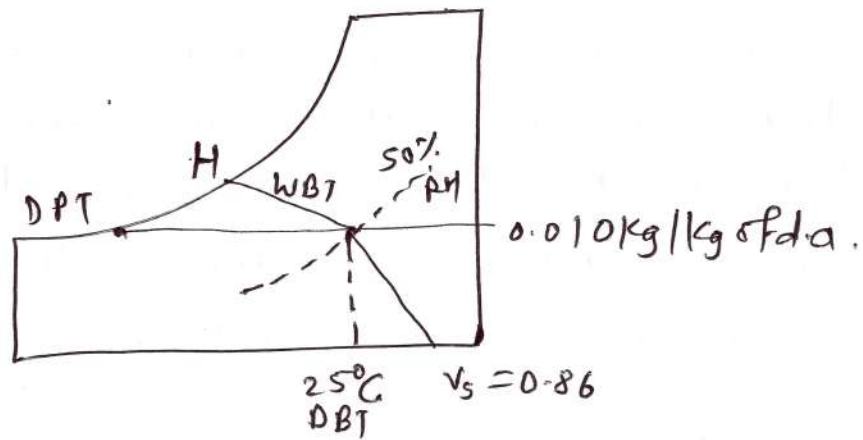
2] With the help of psychrometric chart find the
 following properties of air at 25°C DBT & 50%
 Relative humidity.

1) DPT 2] WBT 3) sp. vol. of air

4) Enthalpy of air 5) sp. humidity of air

Draw psychrometric chart showing all above
 properties.

$DPT = 14^{\circ}C$, $WBT = 18^{\circ}C$, $v_{air} = 0.86 m^3/kg$ of air
 $H = 52 kJ/kg$ of dry air, $w = 0.010 kg/kg$ of dry air



2.4 Construction & working of window air conditioner

* Window air conditioner →

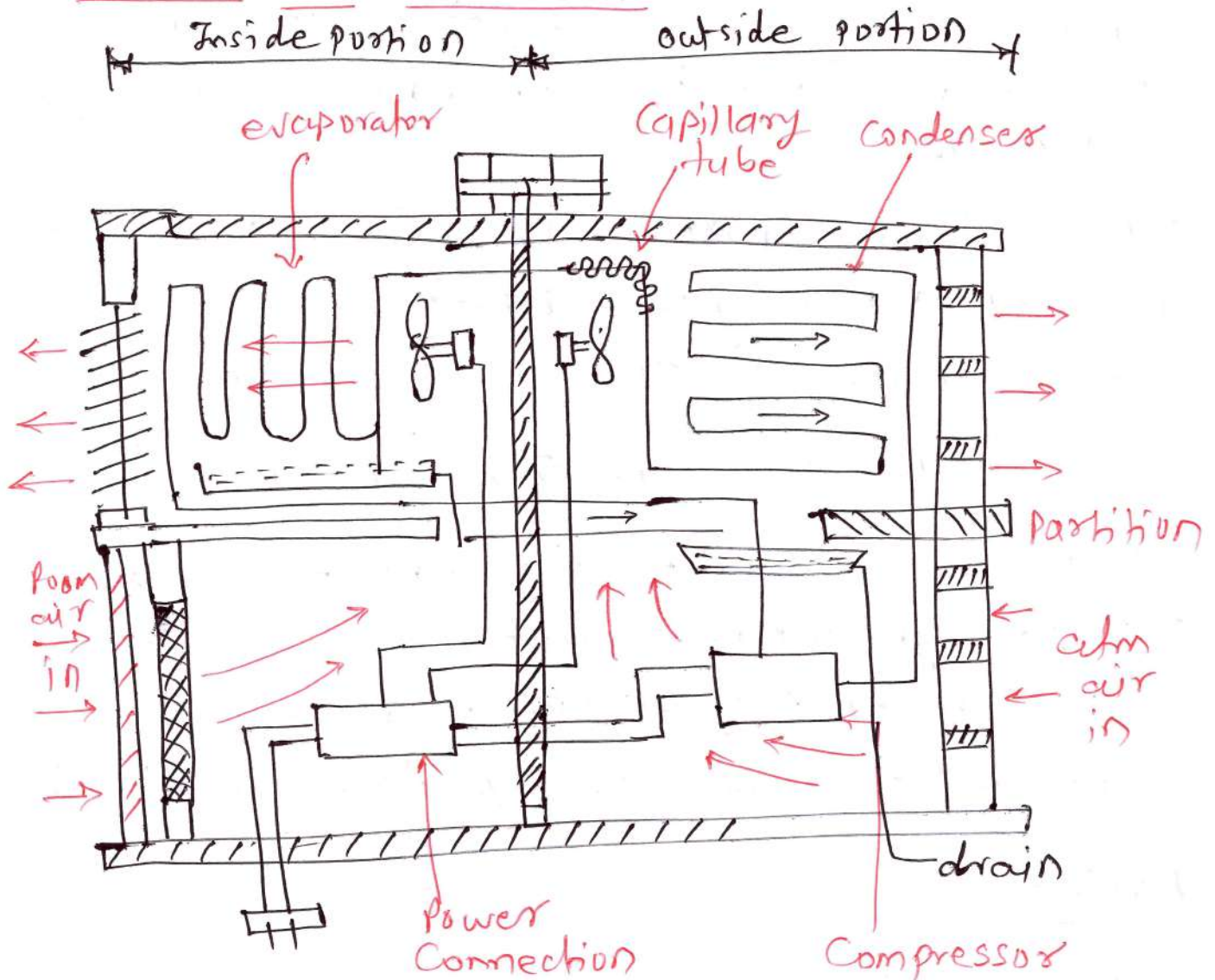


fig. Window air conditioner.

- window room air conditioner consists of casing which is divided into two parts by a vertical partition i.e. outdoor part & indoor part.
- The partition has small opening at the top. The outdoor part fitted outside the room & consists of hermetically sealed compressor, condenser, motor driven fan & a tray.
- The outdoor portion also divided into two parts by partition having small opening to the left side.

Indoor part fitted inside the room consists of evaporator, motor driven fan or blower, Expansion device [capillary tube] & control Panel, an air filter, grill, power connection & a tray.

This indoor portion is divided into two parts by a horizontal partition which has small opening to the right side.

Two trays are connected by a pipe line.

- Condenser is connected to evaporator by capillary tube through filter. Evaporator is connected to compressor by suction pipe & compressor is connected to condenser by discharge pipeline.

Working:-

In this simple vapour compression refrigeration system is used.

The air moving inside the room & in the front part of the air conditioner where the cooling coil is located is considered to be the room air.

- When the window A/C is started the blower starts immediately & after a few seconds the compressor also starts.
- The low pressure, low temperature refrigerant vapour is sucked by hermetically sealed compressor & compressed to high pressure, high temperature.

& discharge to condenser & vapour condenses rejecting the latent heat.

- Due to this the temperature of the room air reduces hence air becomes chilled & circulated back into the conditioned room.
- Due to reduction in the temperature of the air, dew is formed on the surface of the cooling coil. For this purpose the temperature of cooling coil is lower than the DPT of the air.
- The compressor & condenser are fitted such that, the fan draws outside air from lower portion of outside ~~unit~~ unit & flow over condensing coil & discharge outside while passing air over the coil, condenser rejects heat to air, Refrigerant vapours condenses into liquid form.
- When required temperature is achieved the compressor is automatically stop by control Panel. The temperature inside the room can be set by using the thermostat knob control.
- Filter cleans the air before it enters the room.

Application - office, bedroom, drawing hall etc.

Limitations -
1) No control over humidity.
2) No provision for heating in winter
3) No provision for humidification.

Split Conditioning system:-

split AC consists of two units with two separate casing

a) Indoor unit:- evaporator unit,
evaporator blower,
capillary tube, control panel,
air filter, supply & return air
grills.

b) Outdoor unit:- compressor & compressor fan
condenser & condenser fan.

Indoor unit & outdoor unit are connected to each other through tubes & electrical wiring.

Indoor unit situated inside the room to be conditioned, which may be ceiling suspended or wall mounted.

- Indoor & outdoor units are located at small distance as possible.
- outdoor unit is located at higher level than indoor unit.
- the compressor is controlled by a thermostat that detects warm air, it activates the compressor
- The compressor circulates a refrigerant gas increasing the pressure & temperature of the refrigerant & easily discharges to condenser.
- condenser removes heat from the refrigerant & the gas changes phase to liquid. This chilled liquid refrigerant forces through tubing indoors until it reaches the evaporator systems.

Evaporator fan collects the warm air & passes it over a coil containing the chilled liquid refrigerant. The fan system blows this cooled air back into the room by ~~blowing~~ lowering the overall temperature of the space or room.

Adv. of split AC:-

- a) easy for maintenance
- b) quieter operation
- c) no need to block windows.
- d) suitable for large capacity building.

disadvantages:-

- 1] high cost, twice the window A/c
- 2] high installation cost
- 3] more heat loss. because inside & outside unit.

APP:- building, schools, retail shops, bank etc.

2/4 way ceiling mounted cassette air conditioner.

- 2 way cassette have air vent on two opposite side directing air flow horizontally
- Indoor unit is installed in the ceiling.
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- The 4-way cassette air conditioner have air vent on all four sides that distributes air in four directions in horizontally & vertically provided with 4 way swing adjustable louvers.

Done
17/08/2028