Latent heat plays an important role in Refrigeration and Air conditioning. Human beings generate Latent heat by way of moisture (perspiration) on the skin. This perspiration requires to be dried and therefore, a change of its state from liquid to vapour is required. Fresh air, which is added into the air system, very often bring in plenty of moisture with it. Removal of this additional moisture also involves latent heat removal.

A portion of the air conditioning heat load is therefore in the form of latent heat. For example, in an office 15% of the air conditioning heat load could be in the form of latent heat. This goes upto around 30% in a restaurent and around 35% in a movie theatre.

An air conditioner manages the five critical constituents :

Air Purity – Advanced filters for the purest air inside

Air Flow – Gets air to every corner of the room

Air Humidity – Maintains optimum humidity levels in all seasons

Air Odour – Removes organic compounds and odour

Air Temperature – Feel comfortable, in summer and winter

Air-conditioning is the conditioning of air for temperature, cleanliness, humidity and directing its distribution to meet requirements of a conditional space. Basically there are two types of air-conditioning one is for providing comfort to occupants of the conditional space and other is industrial air-conditioning, it is used when the primary function is other than comfort, for example food processing, storage of food and other materials.

Main parts in an Air Conditioning system are :

1. **Circulation fan :** Used to move air to & from the room.
2. **Air conditioning unit :** Cooling and dehumidifying process for summer and heating & humidification process for winter.
3. **Supply duct :** It supplies the conditioned air at proper space or point.
4. **Supply outlets :** It distributes the conditioned air evenly in the room.
5. **Return outlets :** It is used to send room air to return duct.
6. **Filters :** It is used to remove dust, dirt and other harmful bacteria from air.

9.4.1. Broad classifications of Air conditioning system. The Air conditioning system may be classified as follows :

1. According to the purpose
   (*i*) Comfort air conditioning system
   (*ii*) Industrial air conditioning system
2. According to weather of the year
   (*i*) Winter air conditioning system
   (*ii*) Summer air conditioning system
   (*iii*) Year-round air conditioning system.

3. According to the arrangement of equipment
   (*i*) Unitary air conditioning system
   (*ii*) Central air conditioning system.

1. According to the purpose

(*i*) **Comfort Air Conditioning System.** It is used for providing comfort to occupa of conditional space. It may be adopted for small space, cabins, office halls, cine halls. DBT and relative humidity should be 21°C, 56% respectively under normal conditio In comfort air conditioning system, the air is brought to the desired DBT and relati humidity.

(*ii*) **Industrial Air Conditioning System.** It is used when the primary function is othe than comfort. Due to sophisticated electronic equipment, for proper working of the machines, DBT (dry bulb temperature) and relative humidity of air is kept constant for example food processing, storage of food etc.

2. According to weather of the year

(*i*) **Winter Air Conditioning System.** In winter season heat is required, so air is heat as per the desired dry bulb temperature and generally humidified and then supplied conditioned space by the fan.

The schematic arrangement of the winter air conditioning system is figured out below Fig. 9.1.

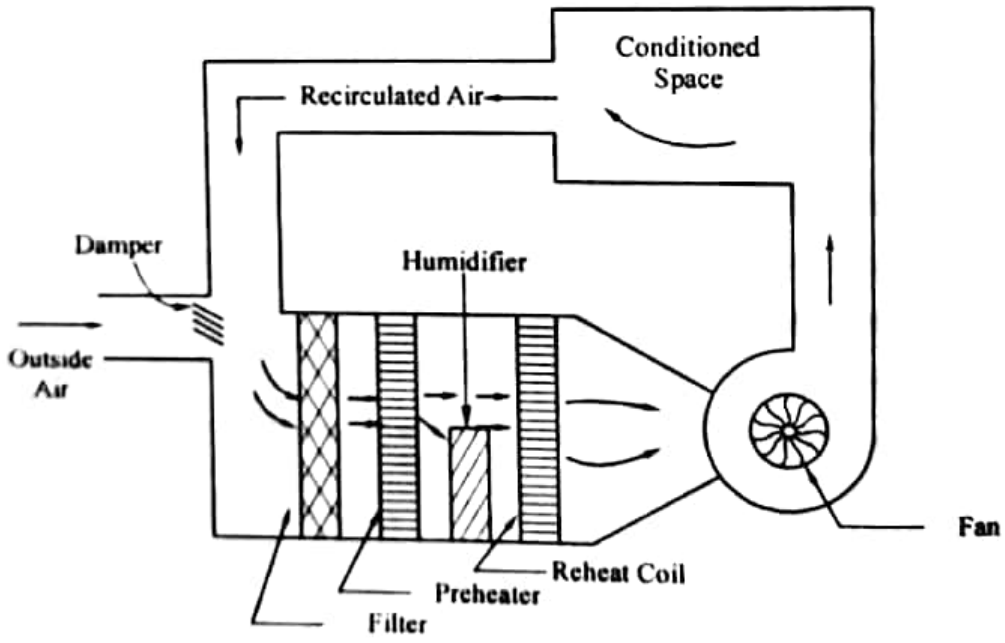

Fig. 9.1. Winter air conditioning system.

Air comes from outside through damper then mixup with recirculated air. A filter removes dirt, dust and other particles. After that air passes through pre heater, humidifier, reheat coil and then supplied to conditioned space.

A part of conditioned space air is exhausted by exhaust fans or ventilators to the open

atmosphere and remaining part, called as recirculated air, is mixed up with fresh outside air.

(*ii*) **Summer Air Conditioning System.** In summer season air is cooled and generally dehumidified then supplied to conditioned space. The schematic arrangement of summer air conditioning system is shown out below in Fig. 9.2.

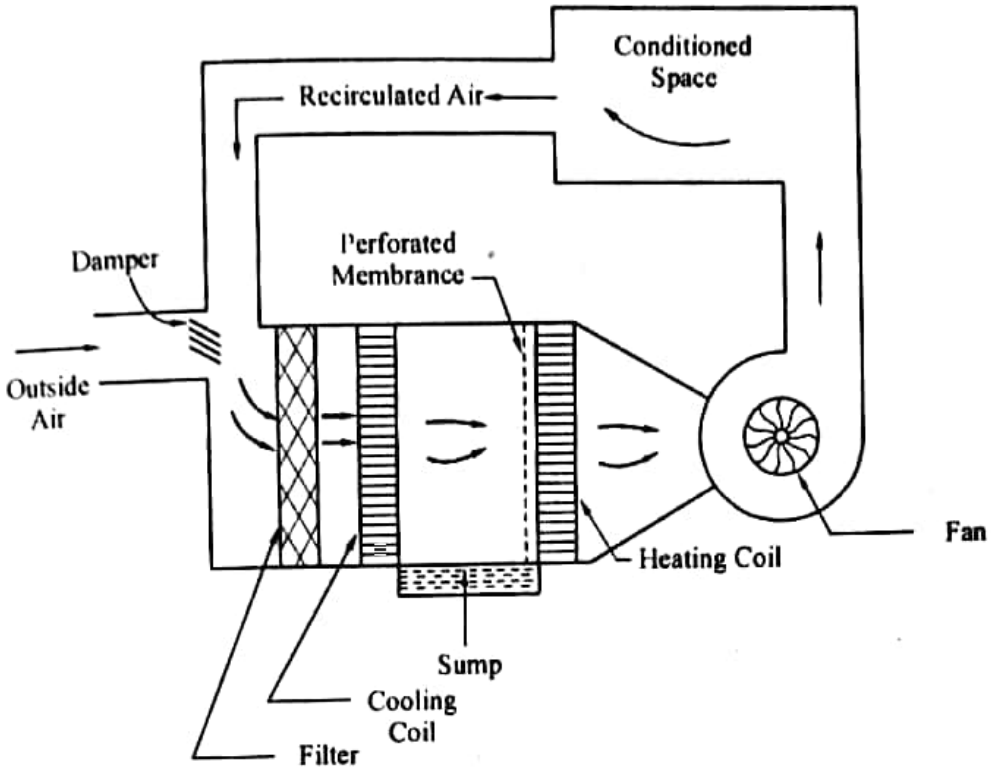

Fig. 9.2.

Out side fresh air from damper and recirculated air from conditioned space passes through a filter for removing small particles, dirt, dust and other impurities and then passes through cooling coil. Then after removing its moisture, in the condensed form, it passes through the heating coil which heats up the air to the desired dry bulb temperature and relative humidity. After that air is supplied to conditioned space by a fan. A part of conditioned space air is exhausted by exhaust fans or ventilators to the open atmosphere and remaining part of air, called recirculated air, is mixed up with fresh outside air.

(*iii*) **Year-round Air Conditioning System.** This system having combination of both winter and summer air conditioning. So, one part is used in winter (heating & humidification) and other part is used in summer (cooling & dehumidification).

3. According to the arrangement of equipment

(*i*) **Unitary Air Conditioning System.** This system is of the following two types :

(*a*) **Window units :** These are mounted in a window or through the wall. It is used to condition the air of one room only. According to the requirement more than one window unit can be used.

(*b*) **Vertical packed units :** These A/C units are of higher capacity than the window units and are installed adjacent to the space to be conditioned. It is used in a restaurant, bank or small office etc.

(*ii*) **Central Air conditioning System.** This is used where air conditioning capacity required is 25 tonnes or more and different zones in a building are to be conditioned.

9.4.2. Factors Affecting Comfort Air Conditioning.

Main factors for comfort air conditioning are explained as below :

1. Temperature of air
2. Humidity of air
3. Purity of air
4. Motion of air.

1. **Temperature of air.** A human being feels comfortable when the air is at 21°C with 56% relative humidity. In air conditioning, temperature of air have to be maintained at any desired level within an enclosed space even though outside of the enclosed space air temperature may be higher side or below side than the desired temperature of enclosed (room) space.

2. **Humidity of air.** Humidity means moisture content present in the air. The control of humidity of air means the increasing or decreasing of moisture contents of air in different weather conditions in order to maintain comfortable and healthy conditions. In summer relative humidity should not be less than 60% and in winter for air conditioning it should not be more than 40%.

3. **Purity of air.** Proper filtration, cleaning and purification of air is essential because people do not feel comfortable when breathing contaminated air, even though temperature and humidity are maintained within acceptable limit.

4. **Motion of air :** Proper air circulation and equi-distribution of air throughout the space are required for maintaining constant temperature throughout the conditioned space.

9.4.3. Air-Conditioning Load

Any heat generated within the space to be air conditioned forms a 'load'on the air conditioning system.

Examples of 'heat–generators' within a space are equipments such as bulb, fan, computer, TV, photocoperier etc. and the people.

Heat also enters the enclosed space from outside. Such heat is a significant load on the air conditioning system. Heat from outside can enter through :

(*i*) Roof

(*ii*) Walls

(*iii*) Glass (window/glazing)

(iv) Open doors and so on.

When an air conditioning system is planned, the planning engineer takes into consideration all possible sources of heat in the space and calculate the required capacity (tonnage) of the air conditioner.

9.4.4. Energy Saving Opportunities in an air-condition system :

(a) Avoid Refrigeration and Air-conditioning to the extent possible :
  (i) Use evaporative cooling for comfort cooling in dry areas.
  (ii) Use cooling tower water at higher flows for process cooling.

(b) Operate at higher temperature :
  (i) The approximate thumb rule is that for every 1°C higher temperature in the evaporator, the specific power consumption will decrease by about 2 to 3%,
  (ii) Increase the chilled water temperature set point, if possible
  (iii) Improve air distribution and circulation,

(c) Accurate measurement and control of temperature.

(d) Reduce Air-conditioning volume and shift unnecessary heat loads :
  (i) Keep unnecessary heat loads out,
  (ii) Use false ceilings,
  (iii) Use small "Power Panel" coolers,
  (iv) Flow optimisation and frequent cleaning/de-scaling of all heat exchangers minimise the process heat loads.

(e) Minimise heat ingress :
  (i) Check and maintain thermal insulation,
  (ii) Insulate pipe fittings,
  (iii) Use landscaping to the reduce heat load,
  (iv) Reduce excessive window area,
  (v) Use low emissivity (sun control) films,
  (vi) Use low conductivity window frames,
  (vii) Provide insulation on sun-facing roof and walls,
  (viii) Provide evaporative roof cooling,
  (ix) Use high speed doors for cold storage.

(f) Using favourable ambient conditions :
  (i) Use cooling tower water directly for cooling in winter,
  (ii) Design new air-conditioning systems with facility for 100% fresh air during winter.