TOPICS TO BE COVERED….

- Definition, Application & Principle of refrigeration
- Types of refrigeration system
- Components of vapor compression cycle, working and Coefficient of performance
- Refrigerants
- Introduction to air conditioning
- Terms Used
- Comfort conditions
- Principle of Comfort conditions
- Packed air conditioner, Split air conditioner, Central air conditioner unit
- Introduction to Psychometric terms & charts

REFRIGERATION:

- Science of providing and maintaining temperatures below that of surroundings.

- Refrigeration is the removal of heat from a material or space, so that it's temperature is lower than that of it's surroundings.

- Refrigeration is a process of moving heat from one location to another in controlled conditions.

Applications of Refrigeration:

1. Residential and office buildings
2. Hospitals, cinema halls and departmental stores
3. Libraries, museums, computer centers and research laboratories
4. Transport vehicles:
    a). Cars, buses and rail coaches
    b). Aircrafts, space shuttles and rockets
    c). Submarines
5. Printing, textile and photographic products
6. Food and process industries
7. Production shop laboratories, manufacture of materials and precision devices

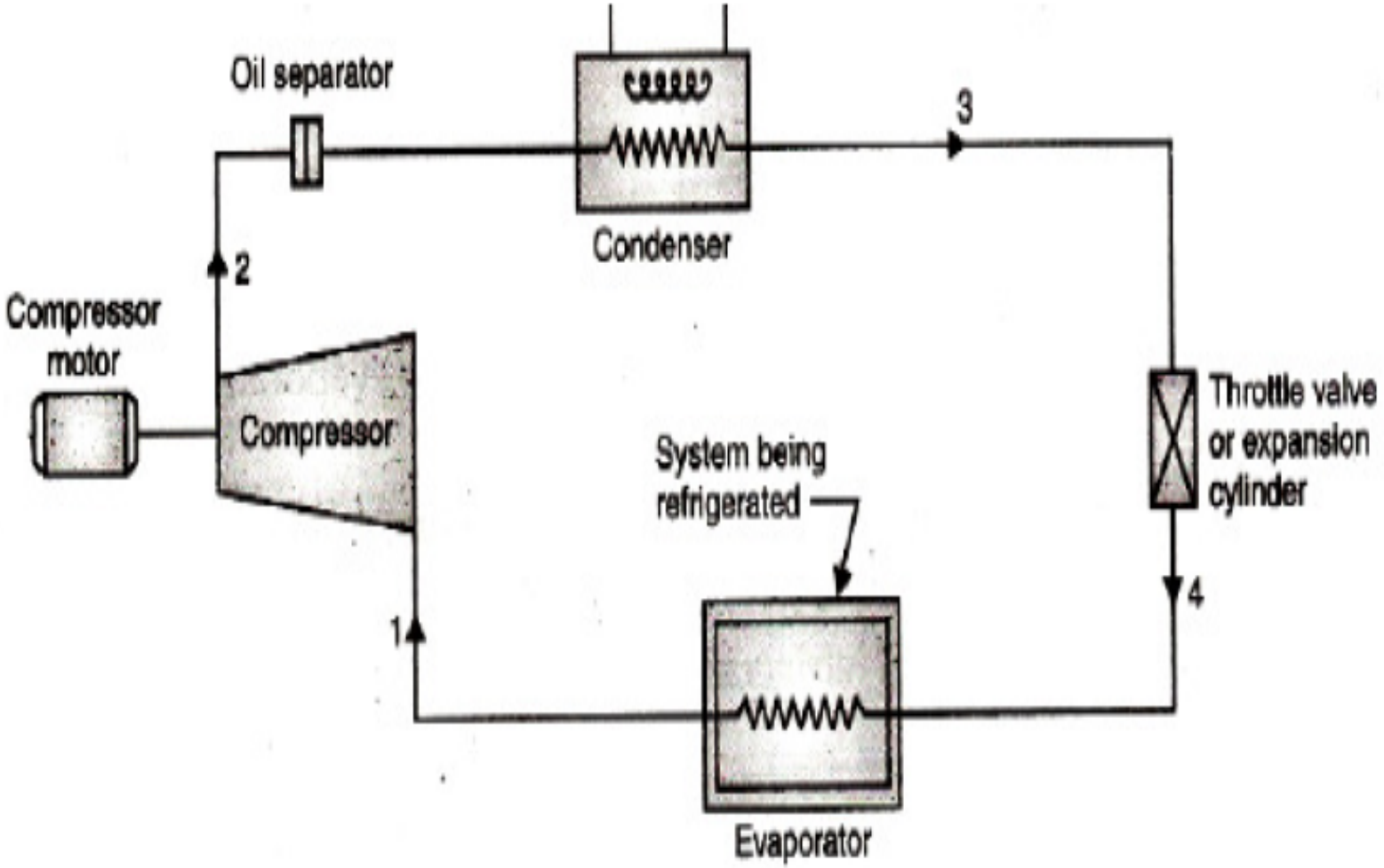
The Refrigeration Cycle

There are four main components in a refrigeration system:

- **The Compressor**
- **The Condensing Coil**
- **The Metering Device**
- **The Evaporator**

Two different pressures exist in the refrigeration cycle. The evaporator or low pressure, in the "low side" and the condenser, or high pressure, in the "high side". These pressure areas are divided by the other two components. On one end, is the metering device which controls the refrigerant flow, and on the other end, is the compressor.

Vapour Compression Refrigeration Cycle:



THE COMPRESSOR

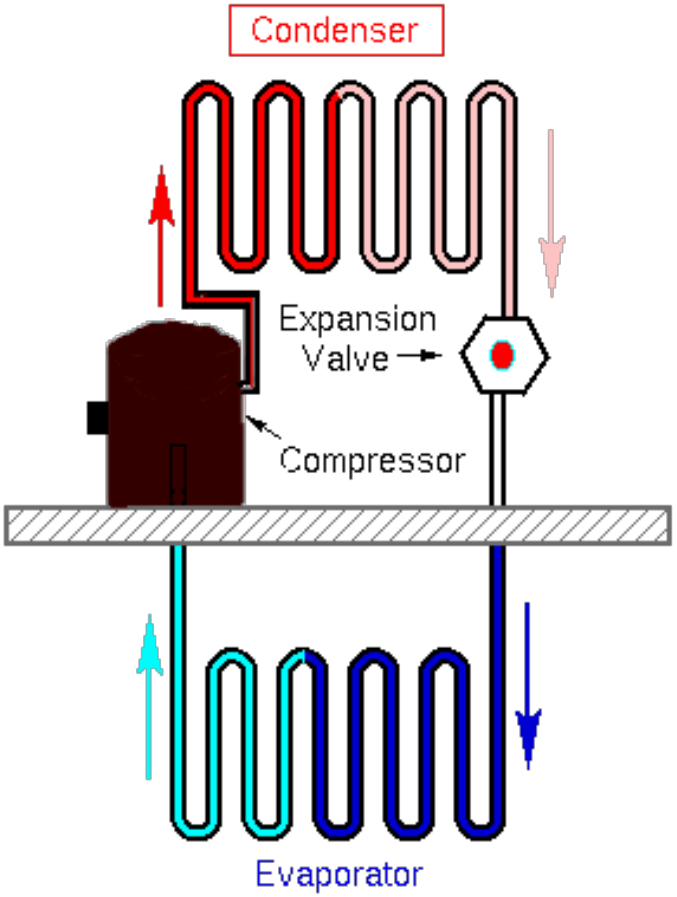
- The compressor is the heart of the system.

- The compressor does just what it's name is.

- It compresses the low pressure refrigerant vapor from the evaporator and compresses it into a high pressure vapor.

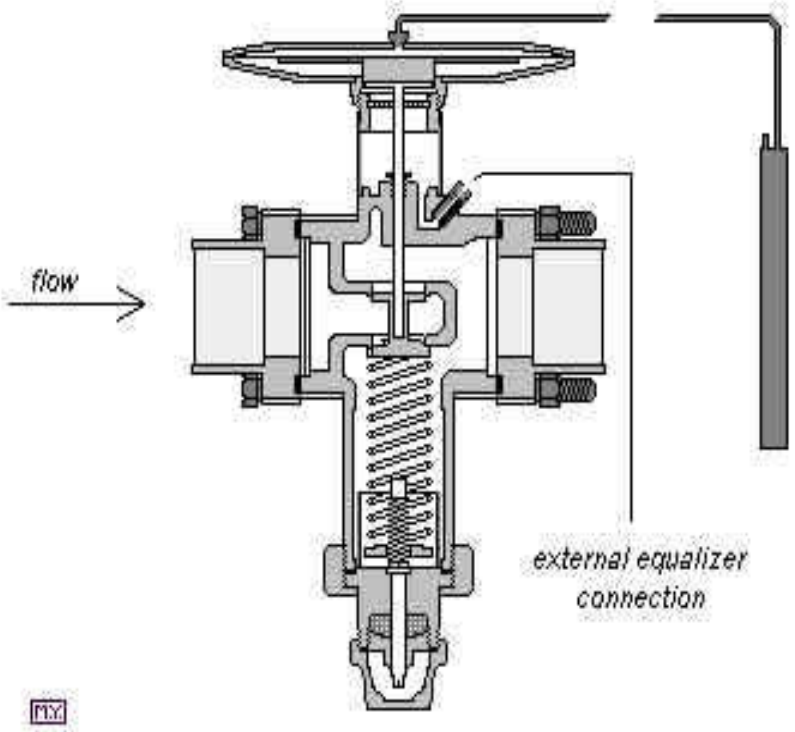
THE CONDENSER

- The hot vapor enters the condenser and starts to flow through the tubes.
- Cool air is blown across the out side of the finned tubes of the condenser (usually by a fan or water with a pump).

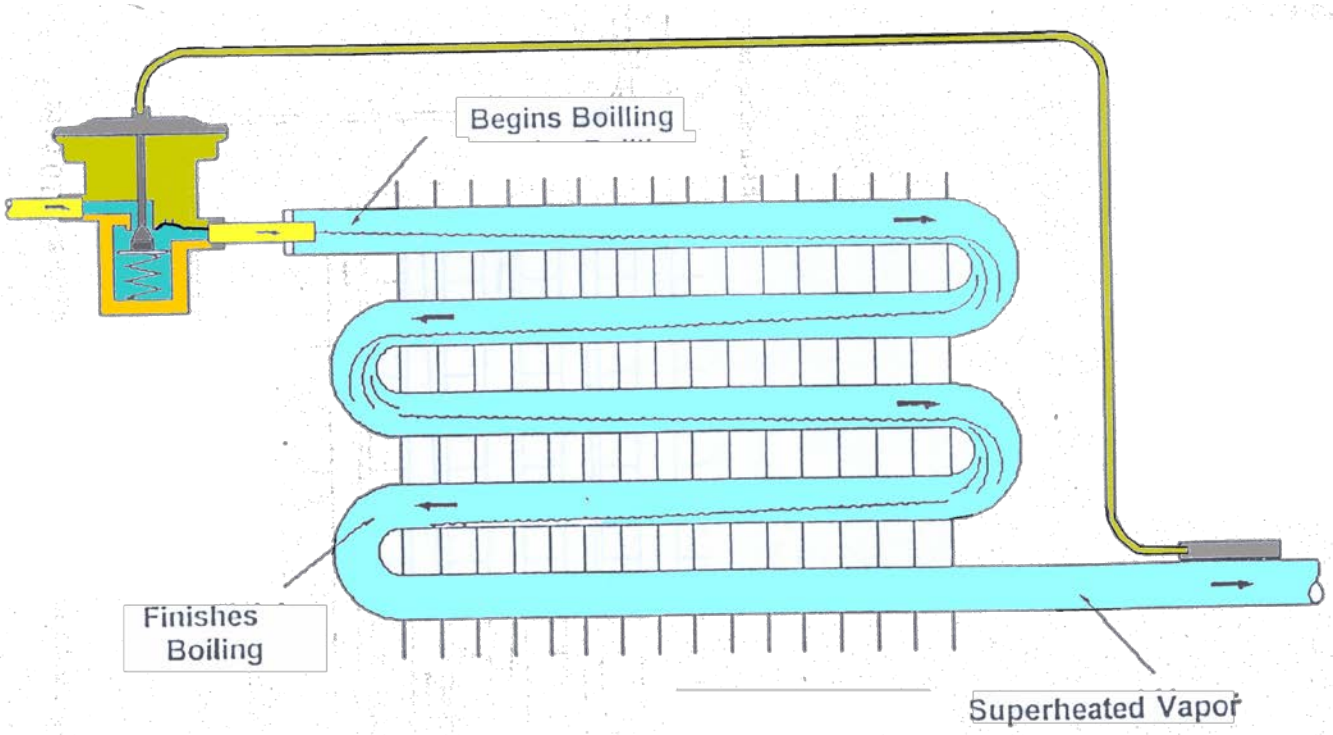


THERMAL EXPANSION VALVES

A very common type of metering device is called a TX Valve (*Thermostatic Expansion Valve*). This valve has the capability of controlling the refrigerant flow. If the load on the evaporator changes, the valve can respond to the change and increase or decrease the flow accordingly.



The Evaporator



- **The evaporator is where the heat is removed from your house , business or refrigeration box.**
- **Low pressure liquid leaves the metering device and enters the evaporator.**
- **Usually, a fan will move warm air from the conditioned space across the evaporator finned coils.**

COEFFICIENT OF PERFORMANCE

COP of a Refrigerator is a ratio of cooling provided to work required.

The equation is:

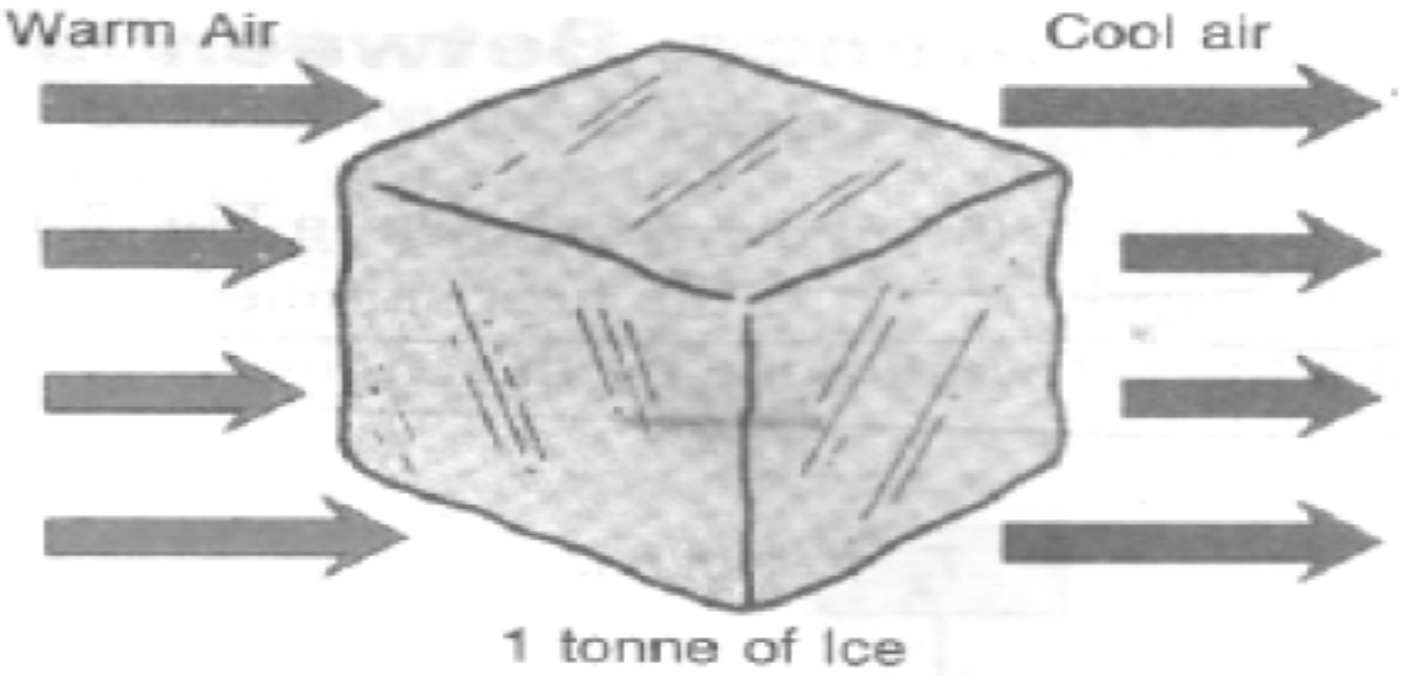
$$COP = Q/W$$

where

- Q is the heat removed from the reservoir.
- W is the work consumed by the heat pump.

Rating of Refrigeration Machine

The practical of refrigeration is expressed in terms of 'tonne of refrigeration' (briefly written as TR). A tonne of refrigeration is defined as the amount of refrigeration effect produced by the uniform melting of one tonne (1000 kg) of ice from and, at 0°C in 24 hours.



Introduction to Air- Conditioning

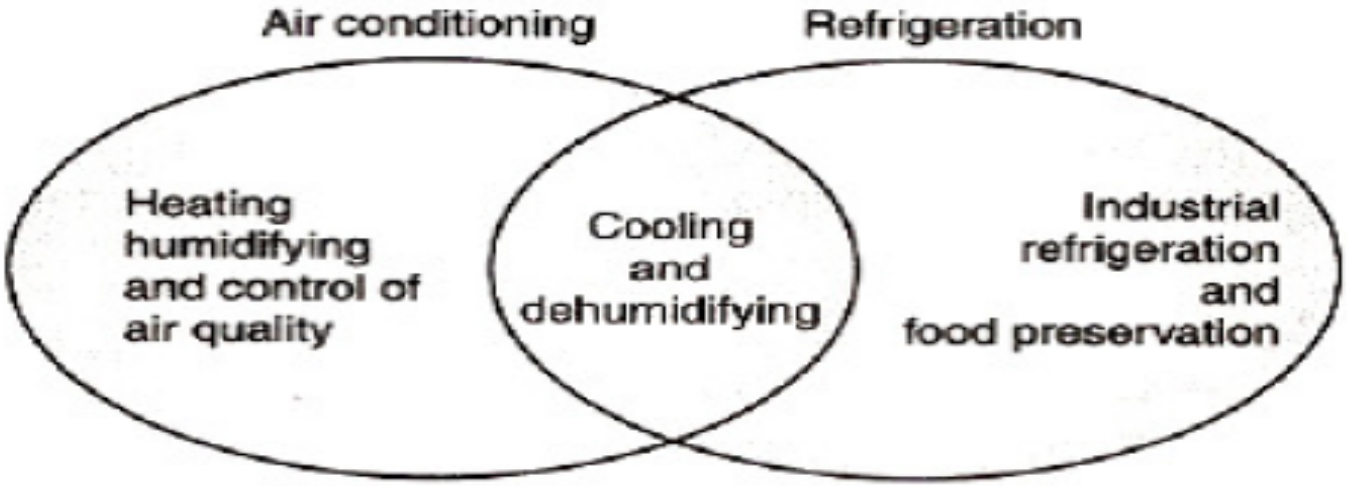
The air conditioning is that branch of engineering science which deals with the study of conditioning of air i.e. supplying and maintaining desirable internal atmospheric condition for human comfort, irrespective of external condition. This subject, in its broad sense, also deals with the conditioning of air for industrial purpose, food processing, storage of food and other materials.

The basic elements of an Air-Conditioning system are as follows:

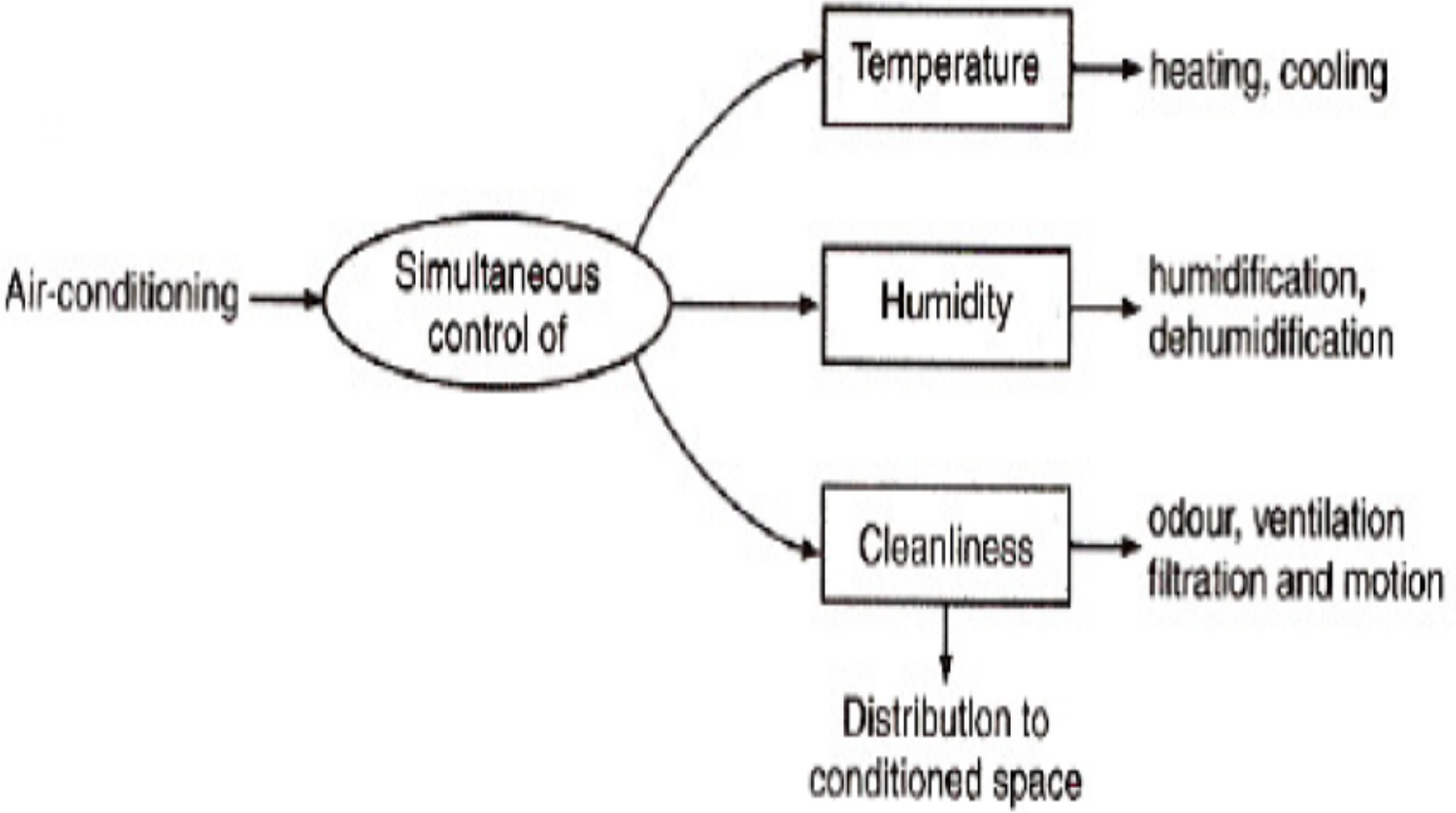
1. Circulation fan
2. Compressor
3. Condenser
4. Dryer
5. Evaporator
6. Supply Duct
7. Supply outlet
8. Return outlet
9. Filters

Applications of Air-Conditioning:

1. Domestic refrigeration
2. Commercial refrigeration
3. Industrial refrigeration
4. Transport refrigeration



Functioning of Air-Conditioning:



Psychrometry

Introduction: The psychrometry is a branch of engineering science, which deals with the study of moist air i.e. dry air mixed with water vapour or humidity. It also includes the study of behavior of dry air and water vapour mixture under various sets of conditions.

Though the earth's atmosphere is a mixture of gases including nitrogen (N_2), oxygen (0_2), argon (Ar) and carbon dioxide ($C0_2$), yet for the purpose of psychrometry, it is considered to be a mixture of dry air and water vapour only.

Psychrometric Terms:

1. **Dry Air**: The pure dry air is a mixture of a number of gases such as nitrogen, oxygen, carbon dioxide, hydrogen, argon, neon, helium etc. But the nitrogen and oxygen have the major portion of the combination.

2. **Moist air**: It is a mixture of dry air and water vapour. The amount of water vapour, present in the air, depends upon the absolute pressure and temperature of the mixture.

3. **Saturated air**: It is a mixture of dry air and water vapour, when the air has diffused the maximum amount of water vapour into it. The water vapours, usually, occur in the form of superheated steam as an invisible gas. However, when the saturated air is cooled, the water vapour in the air starts condensing, and the same may be visible in the form of moist, fog or condensation on cold surfaces.

4. **Degree of saturation:** It is the ratio of actual 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.

5. **Humidity**: It is the mass of water vapour present in 1 kg of dry air, and is generally expressed in terms of gram per kg of dry air (g / kg of dry air). It is also called specific humidity or humidity ratio.

6. **Absolute humidity**: It is the mass of water vapour present in 1 m^3 of dry air, and is generally expressed in terms of gram per cubic-meter of dry air (g/m^3 of dry air). It is also expressed in terms of grains per cubic meter of dry air.

7. **Relative humidity**: It is the ratio of actual mass of water vapour in a given volume of moist air to the mass of water vapour in the same volume of saturated air at the same temperature and pressure. It is briefly written as RH.

8. **Dry bulb temperature**: It is the temperature of air recorded by a thermometer, when it is not affected by the moisture present in the air. The dry bulb temperature (briefly written as DBT) is generally denoted by t_d or t_{db}.

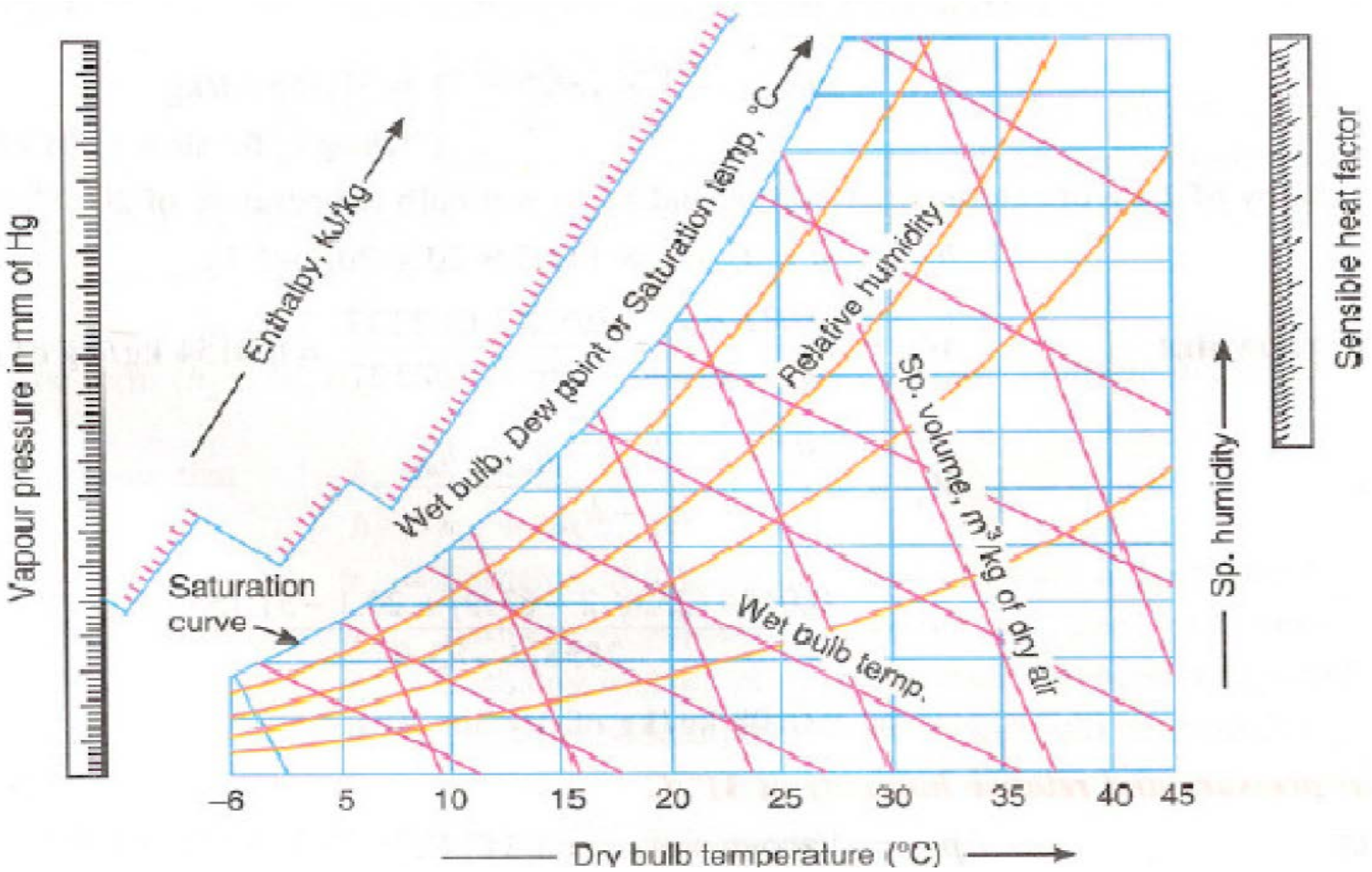
9. **Wet bulb temperature**: It is the temperature of air recorded by a thermometer, when its bulb is surrounded by a wet cloth exposed to the air. Such a thermometer is called wet bulb thermometer. The wet bulb temperature (briefly written as WBT) is generally denoted by t_w or t_{wb}.

10. **Wet bulb depression**: It is the difference between dry bulb temperature and wet bulb temperature at any point. The wet bulb depression indicates relative humidity of the air.

11. **Dew Point Temperature**: It is the temperature of air recorded by a thermometer, when the moisture (water vapour) present in it begins to condense. In other words, the dew point temperature is the saturation temperature (t_{sat}) corresponding to the partial pressure of water vapour (P). It is, usually, denoted by t_{dp}.

12. **Dew point depression:** It is the difference between the dry bulb temperature and dew point temperature of air.

Psychrometric Chart



Human Comfort

"Human comfort is that condition of mind, which expresses satisfaction with the thermal environment"

Factors Affecting Human Comfort:

1. Effective temperature
2. Heat production and regulation in human body
3. Heat and moisture losses from the human body
4. Moisture content of air
5. Quality and quantity of air
6. Air motion
7. Hot and cold surfaces
8. Air stratification.