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**Internal Assessment Test 3 – January, 2019**

Sub:	Elements of Mechanical Engineering				Sub Code:	18ME15/25	Branch:	ME, CIV, ECE
Date:	03/1/2019	Duration:	90 min's	Max Marks:	50	Sem / Sec:	I / I,J,K,L,M,N,O	OBE
<b>Answer any 5 full questions</b>								

		MARKS	CO	RBT
1	Explain with a neat sketch the working of a vapour absorption refrigeration system.	[10]	CO1	L2
2	With a neat sketch explain MIG welding.	[10]	CO1	L2
3	With a neat sketch explain the working of a vertical milling machine.	[10]	CO1	L2
4	Sketch and explain any two robot configurations.	[10]	CO1	L2
5	Explain the following machining operations on Lathe machine with suitable diagram: Turning, Facing, thread cutting and knurling.	[10]	CO 2	L2
6	(i) Define ton of refrigeration, ice making capacity, refrigerating effect, COP and relative COP. (ii) List the ideal properties of refrigerants.	[10]	CO 2	L2
7	Explain the working of a split air conditioner with a neat sketch. How is it different from window air conditioner?	[10]	CO 2	L2
8	Determine the number of teeth and speed of the driver if the driven gear has 60 teeth of 8 mm module and rotates at 240 rpm. The two spur gears have a velocity ratio of 1/4. Also calculate the pitch line velocities.	[10]	CO 2	L2

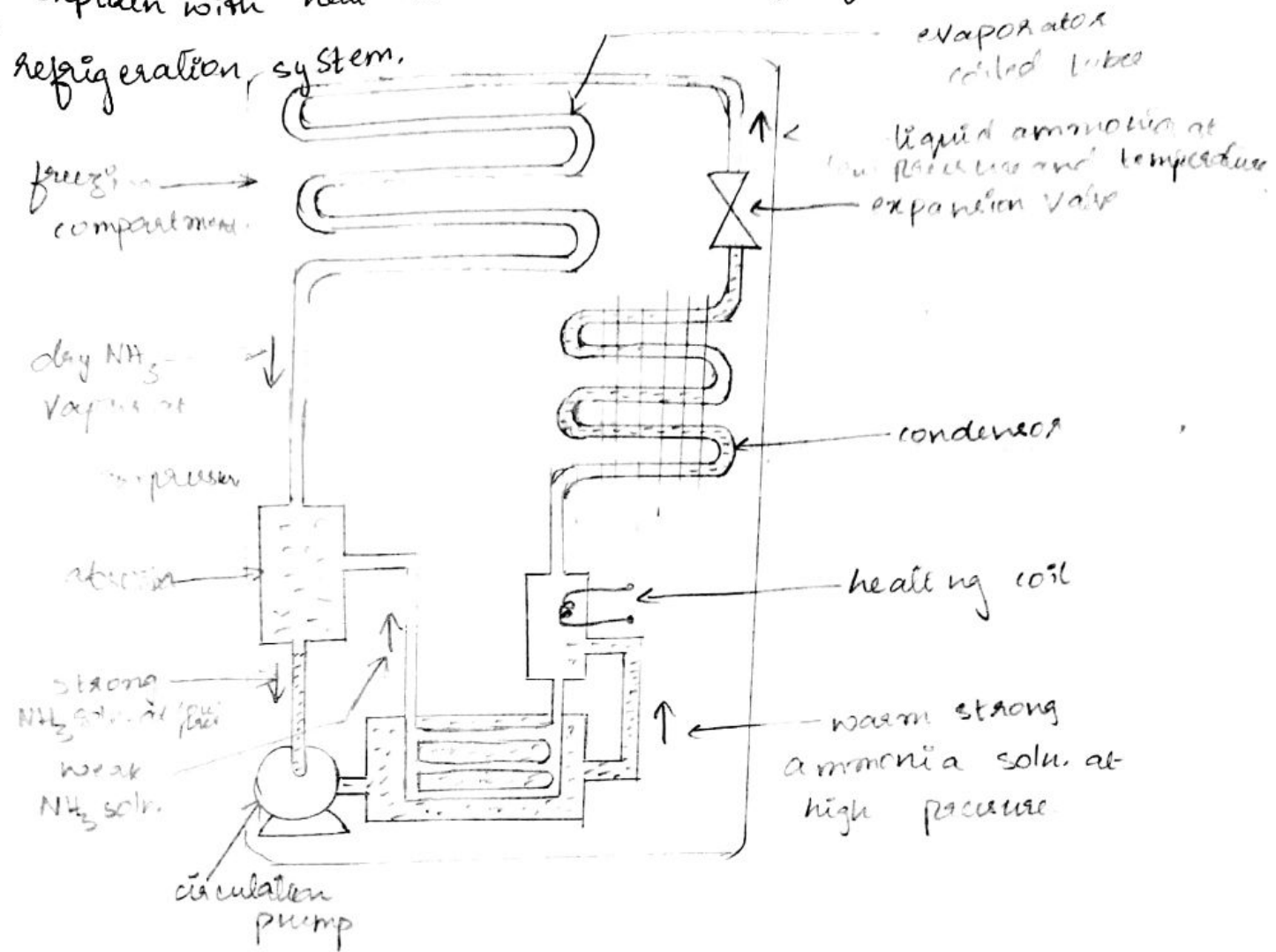
CI

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# ELEMENTS OF MECHANICAL ENGINEERING ASSIGNMENT-3

1. Explain with neat sketch the working of a vapour absorption refrigeration system.



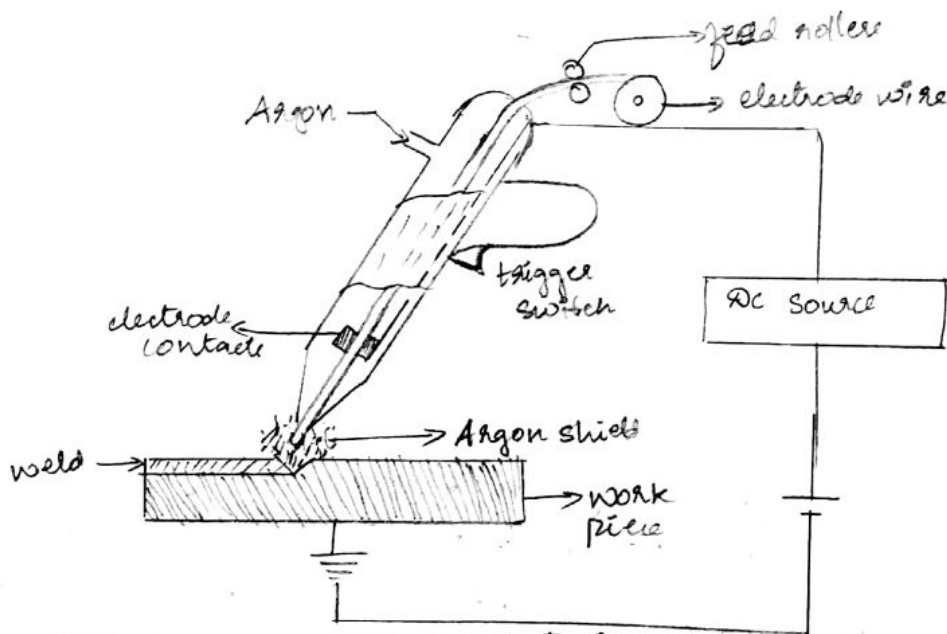
A vapour absorption system makes use of the ability of a substance, called absorbent to absorb large volumes of the vapour of a refrigerant even when cold and reduce it to a liquid, and subsequently give off its vapour when heated. Water which has this ability is the mostly used absorbent, and since ammonia readily dissolves in water & vaporizes when its soln. is heated, is commonly used refrigerant.

This type of refrigerator consists of an absorber, a circulation pump, heat exchanger, heater cum separator, condenser, expansion valve & evaporating coiled tubes.

Dry ammonia vapour is dissolved in the cold water contained in the absorber, which will produce a strong ammonia solution. A circulation pump, draws the strong ammonia solution from the absorber and pumps it to the heat exchanger, where it is warmed by the warm weak ammonia solution which is

② flowing back from the heater - separator. From the heat exchanger, the warm high pressure strong ammonia is passed to the heater separator provided with the heating coils. Heating of the high pressure strong ammonia solution will drive out the  $\text{NH}_3$  vapour from it & consequently the solution in the heater - separator becomes weak which return flow back to the heat exchanger and then to the absorber. The high pressure ammonia vapour from the heater - separator now passes to a condenser, where it is condensed. The high pressure  $\text{NH}_3$  liq. is now expanded to a low pressure and low temperature in the throttle valve. Then the low pressure condensed  $\text{NH}_3$  liquid at low temperature is passed into the evaporator coils provided in the freezing compartment where it absorbs the heat & evaporates. The low pressure  $\text{NH}_3$  vapour from the freezing compartment is passed again to the absorber where it is reabsorbed by dissolving in water and recirculated to repeat the cycle continuously.

2. With a neat sketch explain MIG welding?



- \* MIG welding uses an arc of electricity, that creates a short circuit and a constant anode and a cathode.
- \* Inert shielding gas ( $\text{Ar}$ ,  $\text{He}$ ,  $\text{CO}_2$ ) for protection of weld pool is used.
- \* The short circuit produces heat and melts the metal.
- \* After the heat is removed, the metal cools down and then solidifies creating a new fused metal.
- \* This type of welding can be done either automatically or semi-automatically.

Current - 60 to 500A

Heat I/P - 1 to 25 kJ/s

Application - Medium gauge fabrication such as earth-moving equipment, plate & box girders.

3. Sketch & explain any 4 robotic configurations.

(3)

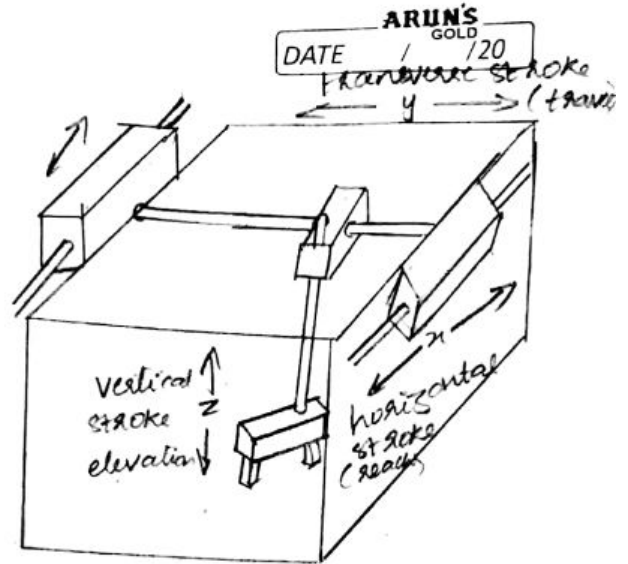
① Cartesian Co-ordinate configuration

Advantages:

- \* linear motion in 3D
- \* Rigid structure
- \* simple kinematic model
- \* easy to visualize
- \* High repeatability & accuracy

Disadvantages:

- \* requires a large volume to operate in
- \* work space is smaller than robot volume
- \* Unable to reach areas under objects
- \* Must be covered from dust



Applications:

- \* Assembly
- \* Handling
- \* Welding
- \* Palletizing & loading-unloading machine tools.

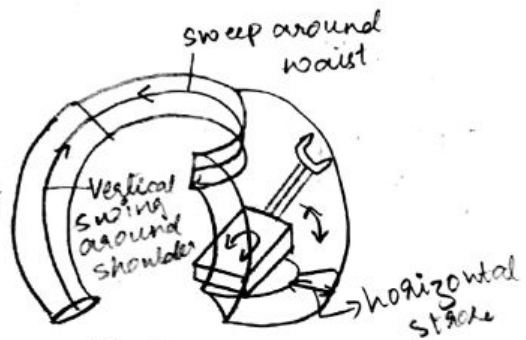
② Spherical configuration:

Advantages:

- \* covers a large volume
- \* Can bend down to pick objects up off the floor
- \* Higher reach ability.

Applications:

- \* Palletizing
- \* Handling of heavy loads



Disadvantages:

- \* complex kinematic model
- \* difficult to visualize.

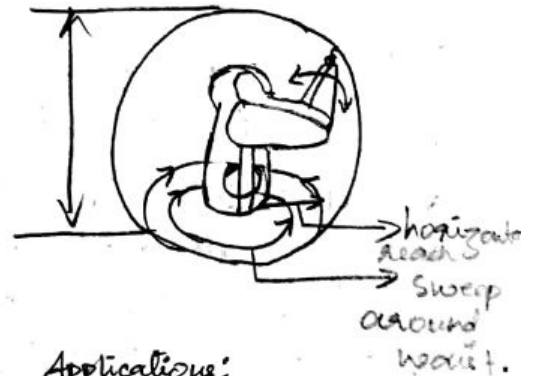
Jointed Arm / Configuration -

Advantages:

- \* Maximum flexibility
- \* cover large space relative to work volume objects off the floor.
- \* Suits electric motor
- \* Higher reachability.

Disadvantages:

- \* complex kinematic model.
- \* Difficult to visualize
- \* Structure not rigid at full reach.



Applications:

- \* spot welding, arc welding

## ② SCARA Configuration.

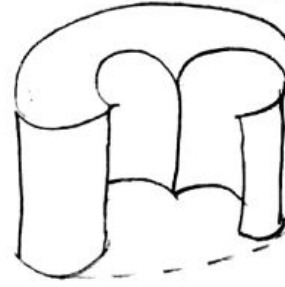
### Advantages-

- \* Floor area is small compared to work area
- \* Compliance.

### disadvantages-

- \* Rectilinear motion requires complex control of revolute joints.

- ### Applications-
- \* Assembly operations
  - \* Inspection & measurements
  - \* Transfer of components.



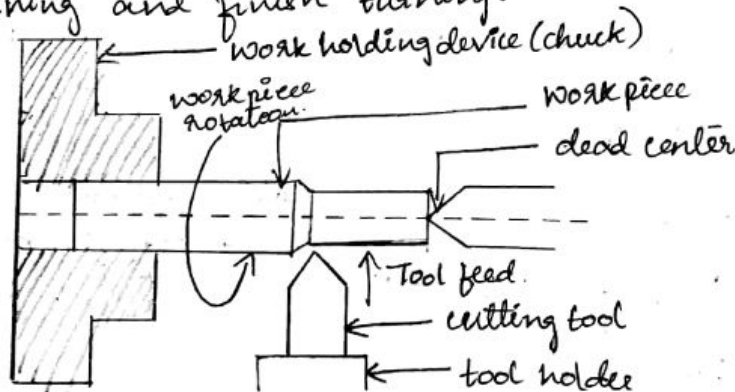
4. Explain the following machining operation on lathe machine with suitable diagram. ① turning ② facing ③ thread cutting ④ knurling

### ① Cylindrical turning-

\* It is the most widely performed operation on the lathe machine. It is also called plain turning.

\* Tool is fed against the work piece in a direction parallel to the lathe axis.

\* Two types of turning can be done on a lathe machine, which is rough turning and finish turning.



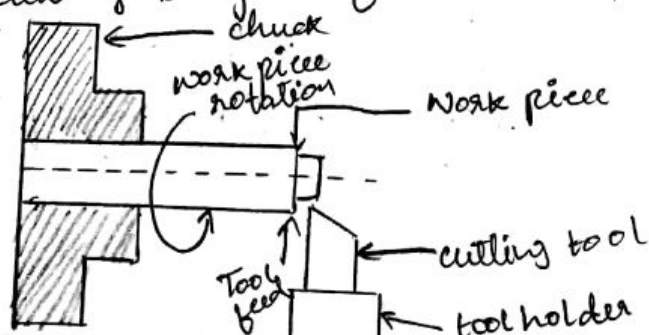
### ② Facing- is the operation of generating flat surface at the end.

\* Work piece is held only at the live centre.

\* Tool is fed perpendicular to the lathe axis.

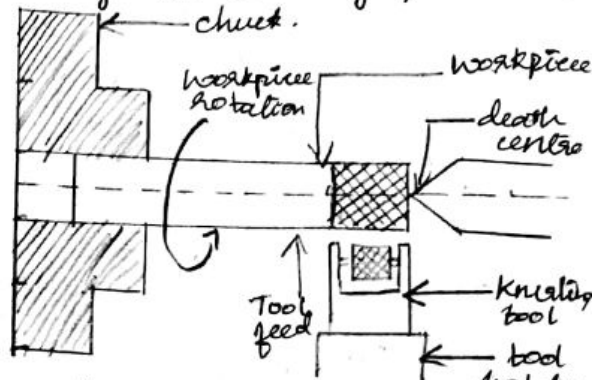
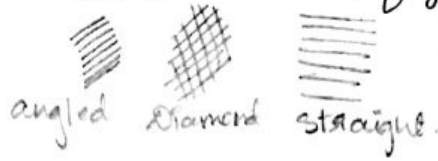
\* length extended from the chuck should not extend 1.5 times the diameter of the work piece.

\* Finishing cuts must always be given from centre to outer edge of the work piece.



③ Knurling is a special operation carried out on lathe to get a visually attractive wire cross pattern on the surface of metal parts.

\* It allows human hands/figure to get a better grip on the object.



④ Thread cutting

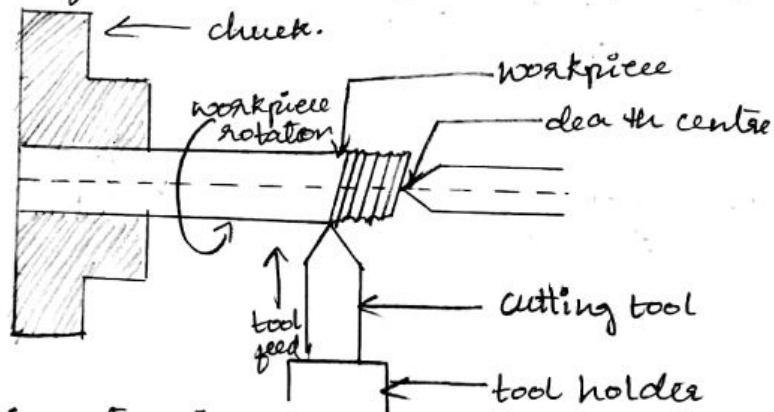
for cutting screw threads on metallic parts.

\* A suitable tool such a V-thread, square thread are selected based on the required thread profile.

\* Thread cutting is basically done in very low speeds.

\* The depth of cut is selected and the tool is made to move parallel to the lathe axis by means of automatic arrangement.

\* During thread cutting, both work piece & lead screw rotate at the same speed. The pitch of the lead screw is equal to pitch of work piece.



5. (i) Define ton of refrigeration, ice making capacity, refrigerating effect, COP & relative COP.

Ton of refrigeration - the quantity of heat absorbed in order to form one tonne of ice in 24 hours when the initial temperature of the water is 0°C.

Ice making capacity - the capacity of the refrigerating system to make ice beginning from water (at room temp) to solid ice.

Refrigerating effect - the rate at which the heat is absorbed in a cycle from the interior space to be cooled.

C.O.P - the ratio of heat absorbed by the refrigerant while passing through the evaporator to the work input supplied.

Relative C.O.P - It is the ratio of Actual C.O.P to the theoretical C.O.P.



(ii) List the ideal properties of the refrigerant -

Thermodynamic properties-

- \* low boiling temperature
- \* low freezing point
- \* high evaporator & condenser pressure
- \* high latent heat of evaporation.

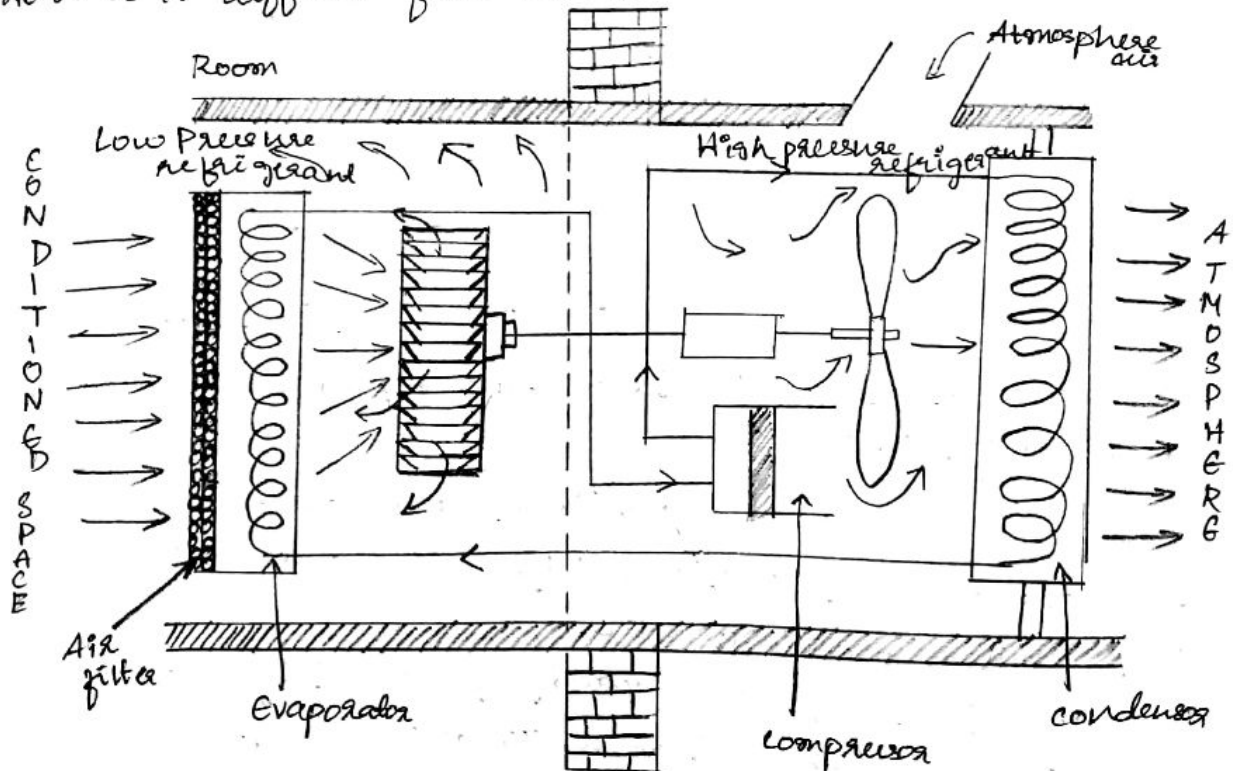
Physical properties-

- \* low specific volume
- \* low viscosity
- \* low specific heat of liquid refrigerant
- high specific heat of vapour refrigerant.

Other properties-

- \* low toxicity
- \* low flammability.
- \* corrosiveness.
- \* high C.O.P
- \* Odourless.

6. Explain the working of split air conditioner with neat sketch. How is it different from window A.C.



The system consists of a compressor, a condenser, an evaporator, a capillary tube, condenser & evaporator fans driven by the same motor. The evaporator fan and the evaporator coils of the unit always lie inside the building or space which is to be conditioned. Condenser and the condenser fan of the unit projects outside the building or space to enable heat transfer with the atmosphere.

The high pressure refrigerant leaving the compressor enters the condenser coils. The latent heat of the refrigerant vapour is given to the surrounding atmosphere. Condensation takes place due to this heat transfer as the condenser fan draws air from outside the building and circulates over the condenser coils. The high temperature liquid refrigerant enters the capillary tube and expands in it. Partial evaporation of the refrigerant takes place in the capillary tube reducing the pressure to evaporator pressure. The cold refrigerant enters the evaporator coils. The evaporator fan continuously draws hot air from the conditioned space and circulates it over the evaporator coils. The hot air passing through the air filters comes in contact with cold evaporator coils & exchanges its heat. The cool fresh air enters the conditioned space. As a result, complete evaporation of the refrigerant takes place which enters the compressor again. The cycle repeats again and again. Desired temperature inside the room can be adjusted by thermostatic control device.

Split AC	Window A.C.
<p>Main design <math>\Rightarrow</math> It splits up into two components.</p>	<p>Non splitting, it is entirely enclosed within one component.</p>
<p>Components <math>\Rightarrow</math> compressor &amp; condenser are part of an external unit while the evaporator coils is the part of indoor.</p>	<p>compressor, condenser, expansion valve &amp; other components work as a single unit, that is cuboid in shape.</p>
<p>Capacity <math>\Rightarrow</math> 0.8 to 2 ton</p>	<p>0.75 to 2 ton</p>
<p>noise factor <math>\Rightarrow</math> minimum</p>	<p>more noisy.</p>
<p>leakage <math>\Rightarrow</math> less</p>	<p>more leakage</p>
<p>wear &amp; tear <math>\Rightarrow</math> Minimum.</p>	<p>more wear &amp; tear</p>



7) determine the no. of teeth & speed of the driver, if the driven gear has 60 teeth & 8mm module & rotates at 240 rpm, the two spur gears have a velocity ratio of  $\frac{1}{4}$ . Calculate pitch line velocities.

$T_2 = 60$   
 $M = 8\text{mm}$   
 $N_2 = 240\text{ rpm}$   
 $VR = \frac{1}{4}$

$VR = \frac{N_2}{N_1} = \frac{T_1}{T_2} = \frac{1}{4}$   
 $\frac{240}{N_1} = \frac{T_1}{60} = \frac{1}{4}$   
 $N_1 = 960 \quad T_1 = 15$

$M = \frac{\text{diameter}}{\text{teeth}}$

$d = M \times \text{teeth}$   
 $= 8 \times 10^{-3} \times 15$   
 $= 120 \times 10^{-3}$

$V_p = \pi N_1 d$   
 $= \pi \times 960 \times 120 \times 10^{-3}$   
 $V_p = 361.91\text{ m/min}$   
 $V_p = 6.031\text{ m/sec}$

8. With a neat sketch explain the working of a vertical milling machine.

In a vertical milling machine the spindle is mounted with its axis vertical to the work table. The column & the base are formed into an integrated casting. The spindle head is fitted vertically in the guide ways. A saddle is mounted over the guideways provided on top of the base. The saddle can be moved in the transverse direction, the work table will be mounted over the saddle & can be moved longitudinally.

