MODULE 3

MODULE-3
REFRIGERATION AND AIR CONDITIONING

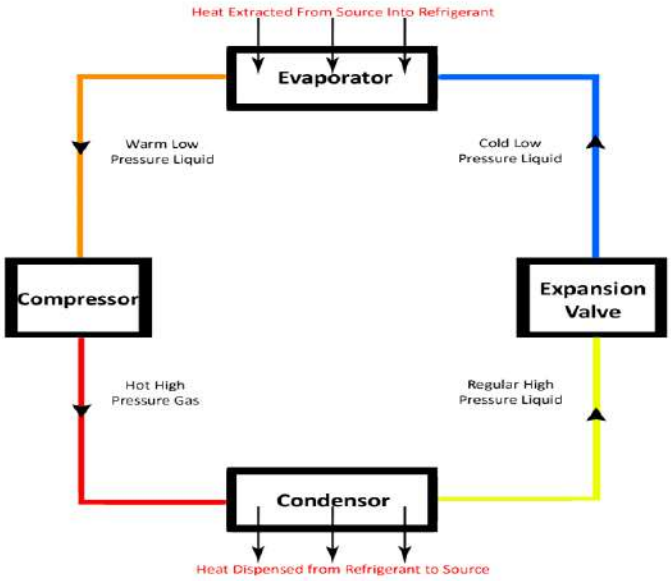
REFRIGERATION: It is defined as a method of reducing temperature of a system below that of the surroundings and maintaining it at the lower temperature by continuously abstracting the heat from it.

REFRIGERANT: The medium or working substance that continuously extracts heat from the space within the refrigerator which is to be kept cool at temperature less than atmospheric by rejecting heat to atmosphere is called refrigerant.

PARTS OF REFRIGERATOR:

A refrigerator consists of following main parts:

1. Evaporator
2. Circulating System (Compressor/Pump)
3. Condenser
4. Expansion Device



1. **Evaporator:** Here the liquid refrigerant evaporates by absorbing heat from the refrigerator cabinet in which the substances have to be cooled are kept. It is also called as cooling coil or freezing coil.

2. **Circulating System:** It consists of mechanical devices such as compressors and pumps necessary to circulate the refrigerant to undergo refrigeration cycle. They increase pressure and temperature of the refrigerant. They are driven by electrical motors.

3. **Condenser:** It is a device wherein the refrigerant vapor gives off its latent heat to the atmospheric air and condenses into liquid so that it can be re circulated in the refrigeration cycle.

4. **Expansion Device:** It is a device which reduces pressure and temperature of the liquid refrigerant before it passes to the evaporator. An expansion valve or capillary tube serves the purpose.

REFRIGERATING EFFECT: The rate at which the heat is absorbed in a cycle from the interior space to be cooled is called refrigerating effect.

UNIT OF REFRIGERATION: The capacity of refrigeration system is expressed in tons of refrigeration.

A ton of refrigeration is defined as the quantity of heat absorbed in order to form one ton of ice in 24hours from water at 0^0C.

In S.I System, 1 ton of refrigeration = **210kJ/min** = **3.5kW**

COEFFICIENT OF PERFORMANCE: The coefficient of performance (COP) of a refrigeration system is defined as the ratio of the refrigerating effect (heat absorbed or removed) to the work supplied.

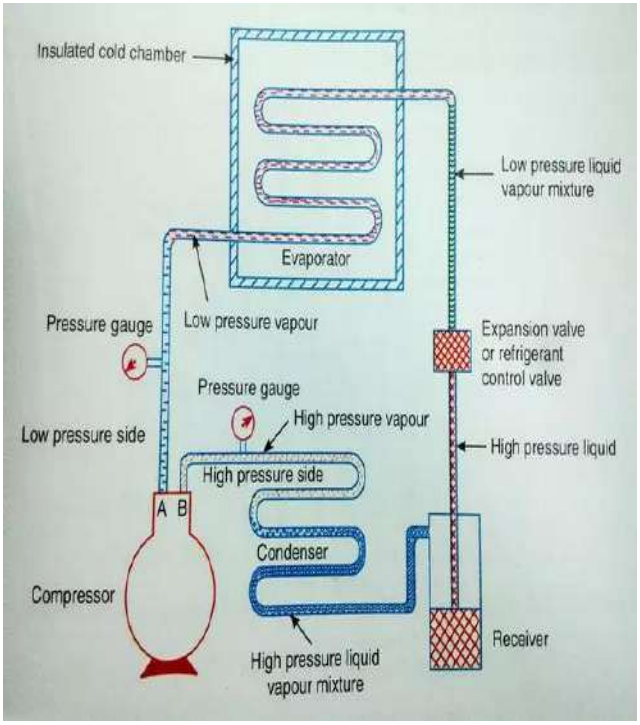
If Q = Heat absorbed or Removed, kW

W = Work supplied, Kw Then, COP = $\frac{Q}{W}$

VAPOR COMPRESSION REFRIGERATOR

PRINCIPLE OF OPERATION: In VCR system the refrigerant alternatively evaporates and condenses, thus undergoing a change of phase from vapor to liquid and again liquid to vapor. During evaporation it absorbs the latent heat from the refrigerated space and gives of the heat while condensing.

SCHEMATIC DIAGRAM:



Principle	Vapor Compression Refrigerator
Working method	Refrigerant vapor is compressed
Type of the energy supplied	Works solely on mechanical energy
Work or mechanical energy supplied	Mechanical energy required is more because refrigerant vapors are compressed to higher pressure
COP	High
Noise	more
Refrigerant	Freon-12 (dichlorodifluoromethane)
Operating cost	high

WORKING:

1. The liquid refrigerant at low pressure and temperature passing in the evaporator coiled tubes absorbs heat from the contents in the freezing compartment and evaporates.
2. The vapor refrigerant at low pressure from evaporator is drawn by the compressor which compresses it to high pressure and hence relatively increases its temperature above atmospheric air.

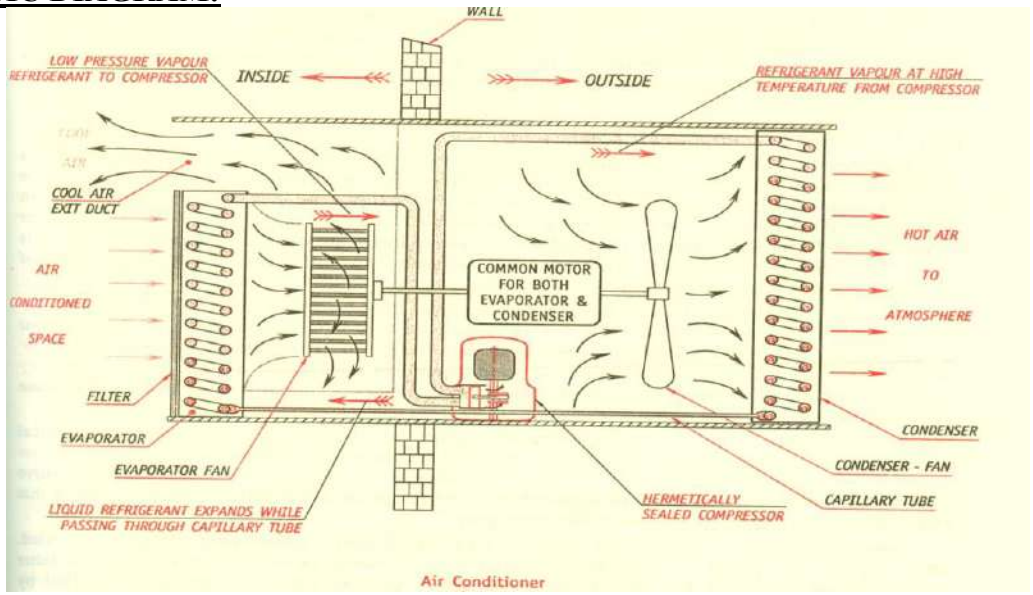
3. The high pressure–high temperature vapor refrigerant from the compressor flows to the condenser where it gives off its latent heat to the atmosphere air. As a result of the loss of latent heat in the condenser, the refrigerant condenses back to liquid.
4. The high pressure liquid refrigerant approximately at room temperature now flows to the throttle valve in which it expands to a low pressure and low temperature of about -10^0C and then passes to the evaporator coils for recirculation again.

ROOM AIR CONDITIONER AND PRINCIPLES OF AIR CONDITIONING:

Providing a pleasant indoor atmosphere by cooling, humidifying or dehumidifying, cleaning and recirculation of surrounding air is called air conditioning.

1. The artificial cooling of air and conditioning it to provide maximum comfort to human beings is called comfort air conditioning.
2. The artificial cooling of air and conditioning it to provide a controlled atmosphere required in some engineering, manufacturing and processing is called industrial air conditioning.

SCHEMATIC DIAGRAM:



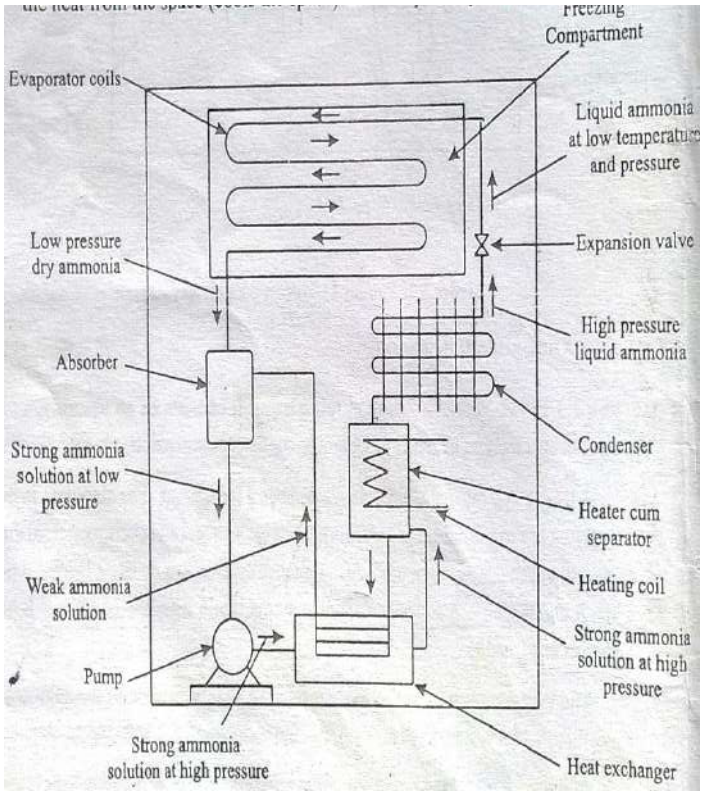
WORKING:

1. It is generally mounted on a window sill such that the evaporator unit is inside the room and the condenser part is outside the building. An air conditioner continuously draws air from an indoor space to be cooled, cools it by the refrigeration principles and discharges back into the same indoor space that needs to be cooled.
2. The high pressure, low temperature liquid refrigerant from the condenser is passed to the evaporator coils through the capillary tube where it undergoes expansion.
3. The refrigerant in evaporator coils absorbs heat from the air passing over it from the interior and evaporates.
4. The high temperature evaporated refrigerant is compressed to high pressure by a compressor and delivered to the condenser, where it is condensed to liquid by giving off the heat to the atmospheric air passing over it.
5. The cooled high pressure refrigerant now passes through the capillary tube where it undergoes expansion and again recirculated to repeat the cycle continuously.

VAPOR ABSORPTION REFRIGERATOR

PRINCIPLE OF OPERATION: The VAR system makes use of the heat energy to change the state of the refrigerant. This system makes use of the ability of the substance called absorbent, to absorb large volumes of vapor of a refrigerant and reduce it to liquid and subsequently give off its vapors when heated.

SCHEMATIC DIAGRAM:



Principle	Vapor Absorption Refrigerator
Working method	Refrigerant vapour is absorbed and heated
Type of the energy supplied	Works solely on heat energy
Work or mechanical energy supplied	Mechanical energy required to run the pump is less since pump is required only to circulate the refrigerant
COP	less
Noise	less
Refrigerant	ammonia
Operating cost	less

WORKING:

1. Ammonia is commonly used as the refrigerant and water as absorbent in this type of refrigerators.
2. In this the ammonia refrigerant vaporizes in the evaporator coils absorbing the latent heat from the freezing compartment thus keeping it cool and rejects this heat in the condenser.
3. Dry ammonia vapor is dissolved in the cold water contained in the absorber, which will produce a strong ammonia solution. The strong ammonia solution from absorber is pumped to heat exchanger where it is warmed by the warm weak ammonia solution flowing back from the generator.
4. The warm high pressure ammonia solution now passes to the generator where it is heated by heating coils. The heating will drive out the ammonia vapor from it.
5. Now the solution in generator becomes weak and flows back to the heat exchanger where it warms up the strong ammonia solution passing through it.
6. The high pressure ammonia vapor from generator now passes to a condenser, where it is condensed. The high pressure ammonia liquid is now expanded to low pressure and low temperature in the throttle valve and is passed onto the evaporator coils provided in the freezing compartment, where it absorbs the heat and evaporates.

DIFFERENCE BETWEEN VAR & VCR

PRINCIPLE	VAPOR COMPRESSION	VAPOR ABSORPTION
Working method	Refrigerant vapor is compressed	Refrigerant vapor is absorbed and heated
Energy supplied	Mechanical	Heat
COP	Higher	Relatively low
Capacity	Up to 1000 tons	Above 1000 tons
Noise	More	Almost quiet
Refrigerant	Freon-12	Ammonia
Leakage problem	Chances are more	No leakage
Maintenance	High	Less
Operating cost	High	Less

REFRIGERANTS COMMONLY USED:

1. **Ammonia –** in vapor absorption refrigerator.
2. **Carbon dioxide –** in marine refrigerators.
3. **Sulphur dioxide –** in household refrigerators.
4. **Methyl chloride –** in small scale & domestic refrigerators.
5. **Freon – 12 –** in domestic vapor compression refrigerators.
6. **Freon – 22 –** in air conditioners.

Ammonia: Used in absorption refrigerator. It has high latent heat of 1300kJ/kg and low specific volume at -15^0 C. It is environmental friendly, will not harm ozone layer. It is widely used in cold storage, ice making plants, etc. Its toxic, flammable, irritating and food destroying properties makes it unsuitable for domestic refrigerators. It is used in industrial refrigeration.
Carbon dioxide: It has low specific volume and hence the plant size is compact. It is used in ships where space considerations are more important. It is cheap, non-corrosive and non-flammable. It has a boiling point of -78.5^0C and low critical temperature of 31^0C.
Sulphur dioxide: It has a boiling point temperature of -25.6^0C and has a high critical temperature of 157.2^0C. It is highly toxic and corrosive in nature. It is used in small plants and domestic refrigerators.
Freon-12: It is colorless, odorless and non-toxic in nature. It is mostly used in domestic refrigerators. It has low specific volume compared ammonia. It has a boiling point of -29.8^0C and critical temperature of 112.1^0C.
Freon-22: It is another refrigerant used from Freon group. It has low specific volume. Its boiling point is -40.8^0C and critical temperature is 96.2^0C. It is used in small and medium commercial plants.

PROPERTIES OF GOOD REFRIGERANT:

A. THERMODYNAMIC PROPERTIES:	REQUIREMENT
1. Boiling point	Must have low boiling point
2. Freezing point	Must have low freezing point
3. Evaporator & condenser pressure	Should be slightly above the atmospheric pressure
4. Latent heat of evaporation	Must be very high

B. PHYSICAL PROPERTIES	REQUIREMENT
1. Specific volume	Must be very low
2. Specific heat of liquid & vapor	Must be low in liquid state & high in vapor state
3. viscosity	Both liquid & vapor states must be low

C. SAFE WORKING PROPERTIES	REQUIREMENT
1. Toxicity	Should be non-toxic
2. Flammability	Should not be flammable
3. corrosiveness	Should be non corrosive
4. Chemical stability	Should be stable & should not decompose

D. OTHER PROPERTIES	REQUIREMENT
1. COP	Must be high
2. Odour	Must be odourless
3. Leakage	Should be easily detectable
4. Action with lubricating oil	Must not react with lubricating oil

HUMIDITY AND ITS CONTROL IN AIR CONDITIONING:

Humidity is defined as the moisture content present in the atmosphere. It will be in the form vapour and the maximum amount depends on the atmospheric conditions. The amount of vapour that will saturate the air increases with the rise of temperature.

For example, at 4^0C, 1000kg of moist air contains a maximum of 4.4 kg of water vapour; at 38^0C, the same amount of moist air contains a maximum of 18kg of water vapour. As the atmosphere is saturated with water, the level of discomfort is high because of the evaporation of perspiration.

ABSOLUTE HUMIDITY: It is defined as ratio of water vapour contained in a given volume of air.

SPECIFIC HUMIDITY: It is defined as the ratio of weight of water vapour to the total weight of air.

RELATIVE HUMIDITY: It is defined as the ratio of the actual vapour content of the air to the vapour content of the air at the same temperature when saturated with water vapour.

INTERNAL COMBUSTION ENGINES

Engine: It is a device which converts heat energy liberated by combustion of fuel into mechanical energy.

Types of engines:

1) External combustion engine:

Here the combustion takes place outside the engine cylinder and the combustion products are supplied to the engine cylinder to convert heat energy into mechanical energy.

2) Internal combustion engine:

In this type of engine the combustion takes place inside the engine cylinder itself.

Classification of I.C engines:

1) Based on fuel used
a) Petrol engine
b) Diesel engine
c) Gas engine
d) Bi-fuel engine

2) Based on thermodynamic cycle
a) Otto cycle engine
b) Diesel cycle engine
c) Dual combustion cycle engine

3) Based on strokes
a) 4 stroke engine
b) 2 stroke engine

4) Based on method of ignition
a) Spark ignition or S.I engine
b) Compression ignition or C.I engine

5) Based on number of cylinders as
a) Single cylinder engine
b) Multi cylinder engine

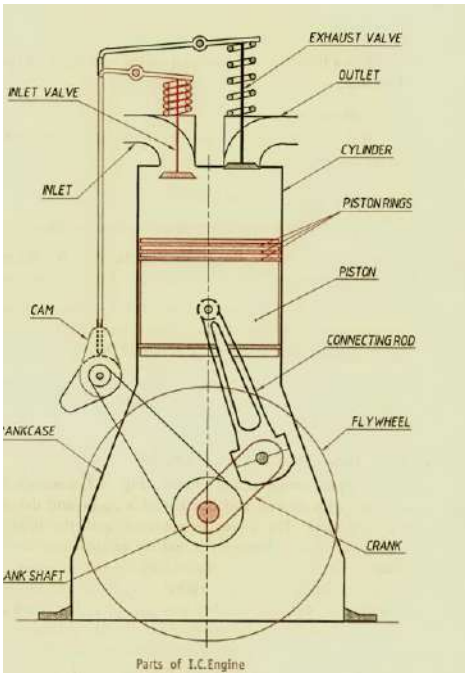
6) Based on position of cylinder as
a) Horizontal engine
b) Vertical engine
c) Vee – engine
d) Opposed cylinder engine
e) Radial engine

7) Based on method of cooling as
a) Air cooled engine
b) Water cooled engine

Parts of I.C engine:

1. **Cylinder:** The heart of the engine is the cylinder in which the fuel is burnt and the power is developed. The piston reciprocates inside the cylinder.
2. **Piston:** The piston is a close fitting hollow cylindrical plunger moving to-and-fro in the cylinder. The power developed by the combustion of the fuel is transmitted by the piston to the crankshaft through the connecting rod.
3. **Piston rings:** The piston rings are the metallic rings inserted into the circumferential grooves provided at the top end of the piston. These rings maintain a gas-tight joint between the piston and the cylinder while the piston is reciprocating in the cylinder. They also help in conducting the heat from the piston to the cylinder.
4. **Connecting rod:** It is a link that connects the piston and the crankshaft by means of pin joints. It converts the rectilinear motion of the piston into rotary motion of the crankshaft.
5. **Crank and crankshaft:** The crank is lever that is connected to the end of the connecting rod by a pin joint with its other end rigidly connected to a shaft called crankshaft. It rotates about the axis of the crankshaft and causes the connecting rod to oscillate.

6. **Crank case:** It is the lower part of the engine serving as an enclosure for the crankshaft and also sump for the lubricating oil.



7. **Valves:** The valves are the devices which controls the flow of the intake and the exhaust gas to and from the cylinder. They are also called poppet valves. These valves are operated by means of cams driven by crankshaft through a timing gear and chain.
8. **Fly wheel:** It is a heavy wheel mounted on the crankshaft of the engine to maintain uniform rotation of the crankshaft.

I.C engine terminology:

1. **Stroke:** It is the distance travelled by the piston from the cover end (TDC) to the crank end (BDC) or from crank end to the cover end. It is denoted by L.
2. **Bore:** It is the diameter of the cylinder or outer diameter of the piston. It is denoted by D.
3. **Top dead centre (TDC) or cover end:** It is the extreme position of the piston, when the piston is near cylinder head.
4. **Bottom dead centre (BDC) or crank end:** It is the extreme position of the piston, when the piston is near the crankshaft end.
5. **Swept volume (Vs):** It is the volume covered by the piston when the piston moves from TDC to BDC. It is denoted by Vs and is given by,

   $Vs= (\prod D^2/4)L$

6. **Clearance volume (Vc):** It is the volume occupied by the charge at the end of compression stroke when the piston is at TDC.
7. **Piston speed:** The total linear distance travelled by the piston per unit time is called piston speed. It is expressed in m/min and is given by,

   Piston speed=2LN m/min

   L= length of stroke in m

   N= speed of the engine in rpm.

8. **Compression ratio (C.R):** It is the ratio of total volume of the cylinder to the clearance volume. i.e., CR or r= Total volume/clearance volume, $r= V_T/V_c = (V_s+V_c)/V_c$

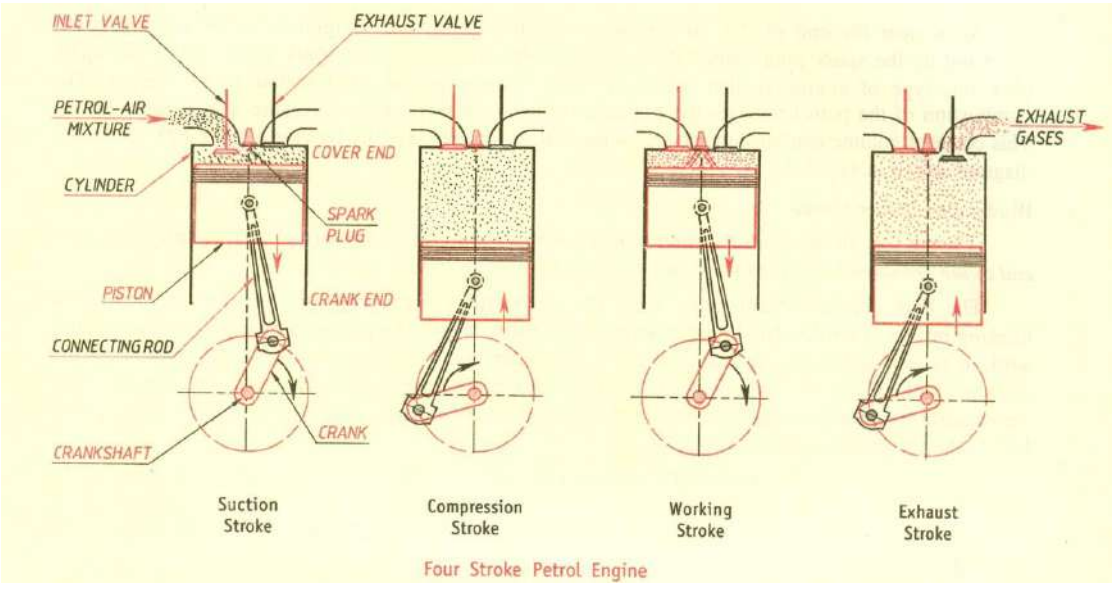
FOUR STROKE PETROL ENGINE:

Features:

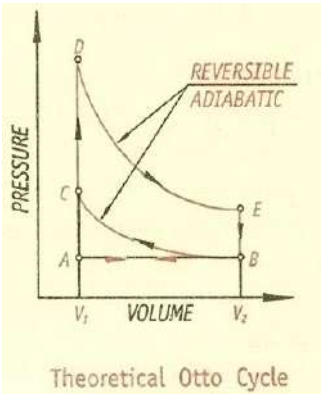
- It consists of a cylinder with its top end fitted with a cover and the other end open.
- The cover is provided with inlet and exhaust apertures which are mechanically operated by valves called inlet and exhaust valve respectively.
- The spark plug fitted at the top of the cover initiates the ignition of the petrol, hence the name spark ignition engine.
- A freely moving piston reciprocates inside the cylinder. The connecting rod and the crank convert the reciprocating motion of the piston into the rotary motion.
- The petrol engines work on the principle of theoretical OTTO cycle, also known as constant volume heat addition cycle.
- The piston performs 4 strokes to complete one working cycle, hence the name 4 Stroke engine. The four different strokes are, i) Suction stroke ii) Compression stroke iii) Working or power stroke iv) Exhaust stroke.

SUCTION STROKE:

- Inlet is open and the exhaust is closed.
- The piston moves from the cover end to the crank end. Crankshaft revolves by half rotation.
- The volume in the cylinder increases, the pressure decreases.
- This sets up a pressure differential between the atmosphere and the inside of the cylinder.
- Due to this pressure differential the petrol & air mixture will be drawn into the cylinder through the inlet valve.
- This stroke is represented by the horizontal line AB on the PV diagram.



Four Stroke Petrol Engine



Theoretical Otto Cycle

COMPRESSION STROKE:

- Both the inlet and exhaust valves are closed.
- Piston moves from crank end to cover end.
- Crankshaft revolves next half revolution.
- The petrol and air mixture contained in the cylinder is compressed.
- The compression ratio of petrol engine varies from 7:1 to 11:1.

- The process of compression is reversible adiabatic or isentropic.
- The process is represented by curve BC on PV diagram.
- At the end of the stroke the high temperature and pressure petrol-air mixture is ignited by electric spark produced by spark plug.
- The constant volume combustion is theoretically represented by vertical line CD on PV diagram.

WORKING OR POWER OR EXPANSION STROKE:

- Both inlet and exhaust are closed.
- Piston moves from cover end to crank end.
- Crank revolves by half revolution.
- The high pressure of the burnt gases forces the piston downwards performing power stroke.
- The linear motion of the piston is converted to rotary motion of the crankshaft by connecting rod.
- The theoretical expansion process of burnt gases is considered as isentropic and represented by curve DE on PV diagram.
- At the end of the stroke exhaust valve opens.
- This brings down pressure in the cylinder to that of atmosphere. The drop in pressure takes place at constant volume theoretically and is represented by vertical line EB on PV diagram.

EXHAUST STROKE:

- Exhaust is open and inlet is closed.
- Piston moves from crank end to cover end.
- Crank revolves by half rotation.
- The burnt gases are expelled from cylinder at atmospheric pressure.
- The process is represented by horizontal line BA on PV diagram. Crankshaft makes two revolutions to complete one cycle.
- The power is developed in every alternate revolution of the crankshaft.

FOUR STROKE DIESEL ENGINE:

Features:

- It consists of a cylinder with its one end fitted a cover and the other end open.
- The cover is provided with inlet and exhaust apertures which are mechanically operated by valves called inlet and exhaust valve respectively.
- The fuel injector mounted in its place injects Diesel fuel supplied by the fuel pump.
- A freely moving piston reciprocates inside the cylinder. The connecting rod and the crank convert the reciprocating motion of the piston into the rotary motion.
- The diesel engines work on the principle of theoretical DIESEL cycle, also known as constant pressure heat addition cycle.
- The compressed air ignites the diesel oil in the engine, hence the name compression ignition engine.

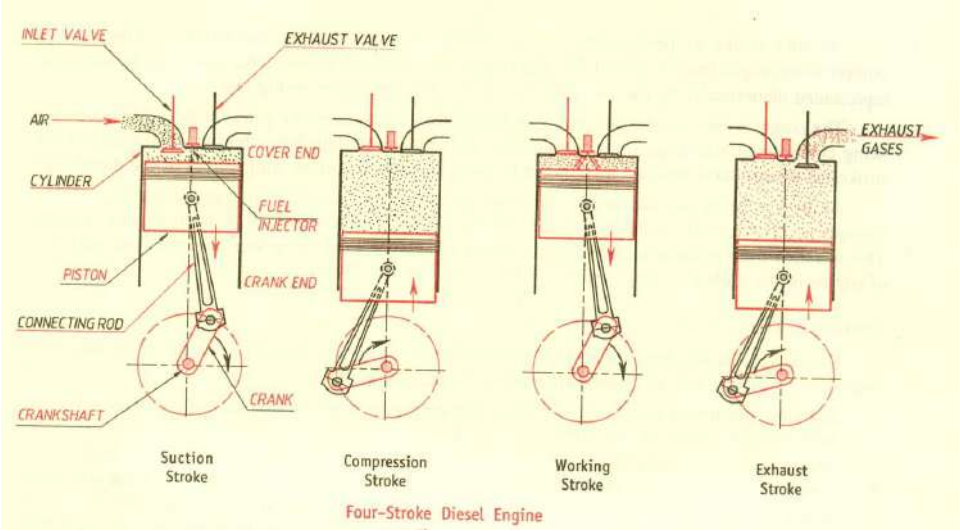
SUCTION STROKE:

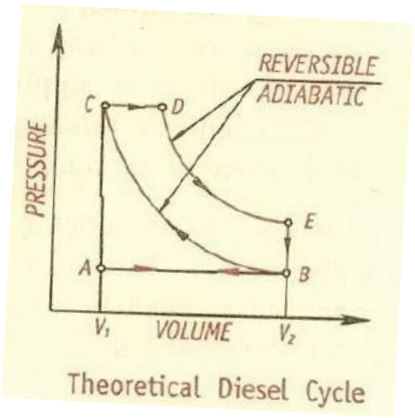
- Inlet is open and the exhaust is closed.
- The piston moves from the cover end to the crank end. Crankshaft revolves by half rotation.
- The volume in the cylinder increases, the pressure decreases.

- This sets up a pressure differential between the atmosphere and the inside of the cylinder.
- Due to this pressure differential only the atmospheric air will be drawn into the cylinder.
- This stroke is represented by the horizontal line AB on the PV diagram.

COMPRESSION STROKE:

- Both the inlet and exhaust are closed.
- Piston moves from crank end to cover end.
- Crankshaft revolves next half revolution.
- The air in the cylinder is compressed.
- The compression ratio of diesel engine varies from 16:1 to 22:1.
- The process of compression is reversible adiabatic or isentropic.
- The process is represented by curve BC on PV diagram.
- At the end of the stroke a metered quantity of diesel oil is sprayed into the cylinder through the injector.
- The high temperature of the air ignites the diesel as soon as it is sprayed and is called self ignition or auto ignition.





WORKING OR POWER OR EXPANSION STROKE:

- Both inlet and exhaust are closed.
- Piston moves from cover end to crank end.
- Crank revolves by half revolution.
- The auto ignition of diesel takes place almost at constant pressure till the injection is completed.
- The high pressure of the burnt gases forces the piston downwards initially and later by expansion of burnt gases performing power stroke.
- The constant pressure combustion is theoretically represented by horizontal line CD on PV diagram.
- The linear motion of the piston is converted to rotary motion of the crankshaft by connecting rod.
- The theoretical expansion process of burnt gases is considered as isentropic and represented by curve on DE on PV diagram.

EXHAUST STROKE:

- Exhaust is open and inlet is closed.
- Piston moves from crank end to cover end.
- Crank revolves by half rotation.
- The burnt gases are expelled from cylinder at atmospheric pressure.
- The process is represented by horizontal line BA on PV diagram.
- Crankshaft makes two revolutions to complete one cycle.
- The power is developed in every alternate revolution of the crankshaft.

TWO STROKE PETROL ENGINE:

The drawing of petrol and air mixture:

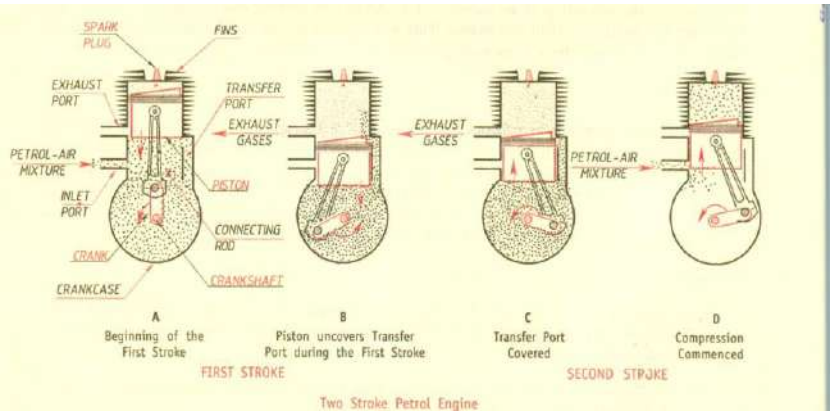
- When the piston ascends a partial vacuum is created in the crankcase until its lower edge uncovers the inlet port.
- The pressure difference between atmosphere and crankcase will draw the petrol-air mixture into the crankcase. The process will continue till the inlet port is covered by the piston during its next descent stroke.
- Further descent of piston compresses the mixture in the crankcase and as soon as the top edge of the piston uncovers transfer port the compressed charge flows from the crankcase through the transfer port into the cylinder. This will continue till the piston covers the transfer port in the next ascending stroke.

FIRST STROKE:

- Piston moves from cover end to crank end.
- The spark plug ignites the compressed petrol and air mixture.
- The hot gases are released during combustion increases the pressure in the cylinder which forces the piston downwards.
- The piston performs the power stroke till it uncovers the exhaust port.
- The combustion gases which are still at high pressure escape through the exhaust port.
- As soon as the top edge of the piston uncovers the transfer port fresh charge flows from crankcase into the cylinder.
- This fresh charge entering the cylinder drives out spent burnt gases through the exhaust port and the process is called scavenging.
- This process is continued till the piston covers both exhaust & transfer port during the next ascending stroke.
- The crankshaft rotates by half rotation.

SECOND STROKE:

- Piston moves from crank end to cover end.
- When it covers transfer port the supply of petrol & air mixture is cut-off.
- Further upward movement covers exhaust port & stops scavenging.
- Further ascend of piston will compress the petrol and air mixture in the cylinder.
- The compression ratio ranges from 7:1 to 11:1.
- After piston reaches cover end, first stroke repeats again.
- The crank rotates by half rotation.



Two Stroke Petrol Engine

COMPARISON BETWEEN PETROL AND DIESEL ENGINES:

PRINCIPLE	PETROL	DIESEL
Cycle of operation	Otto cycle	Diesel cycle
Fuel used	Petrol	Diesel
Admission of fuel	Air & petrol during suction	Diesel oil by injector at the End of compression stroke
Charge drawn during suction	Air and petrol mixture	Only air
Compression Ratio	7:1 to 12:1	16:1 to 22:1
Ignition of fuel	Spark ignition	Compression ignition
Engine speed	High about 7000 rpm	Low from 500 to 3000 rpm
Power output capacity	Less	More
Thermal efficiency	Less	High
Noise & Vibration	Almost nil	High
Weight of the engine	Less	High
Initial cost	Less	More
Operating cost	High	Less
Maintenance cost	Less	Slightly higher
Exhaust gas pollution	More	Less
Starting of the engine	Easily started	Difficult to start in cold weather
Uses	Scooter, motor, cycle, car etc	Trucks, tractors, buses etc.

COMPARISON BETWEEN FOUR-STROKE AND TWO-STROKE I.C. ENGINES:

PRINCIPLE	FOUR-STROKE ENGINE	TWO-STROKE ENGINE
Number of strokes per cycle	Four	Two
Number of cycles per minute (n)	Half of the speed of the engine. n=N/2	Equal to the speed of the engine. n=N
Power	Developed in every alternate revolution of the crankshaft	Developed in every revolution of the crankshaft
Flywheel	Heavier flywheel is required	Lighter flywheel is required
Admission of charge	Directly admitted to the engine cylinder	First admitted to the crankcase & and then transmitted to the engine cylinder
Exhaust gases	Driven through the outlet during	Driven out by scavenging

	exhaust stroke	operation
Valves	Opened & closed by mechanical valves	Opened and closed by piston
Crankcase	Not hermetically sealed	Hermetically sealed
Direction of rotation of crankshaft	Rotates only in one direction	Can rotate in either direction
Lubricating oil consumption	Less	More
Fuel consumption	Less	More
Mechanical efficiency	Low	High
Noise	Less	High
Uses	Slow speed and high power applications like cars, trucks, tractors, jeeps, buses etc.	High speed and low power applications like mopeds, scooters, motorcycles

Advantages of TWO stroke engine over a FOUR stroke engine:

- A two stroke engine has twice the number of power strokes than a four stroke engine at the same speed. Hence theoretically a two stroke engine develops double the power output per cubic meter of the swept volume than a 4S engine running at same speed.
- The weight of a 2S stroke engine is less than the 4S engine because of the lighter flywheel due to more uniform torque on the crankshaft.
- Since there are only 2 strokes in a cycle, the work required to overcome of the suction and the exhaust stroke is saved.
- Since there are no mechanical valves and gears, the construction of a 2S engine is simple which reduces initial cost.
- A 2S engine can be easily started than a 4S engine.
- A 2S engine occupies less space.
- A lighter foundation will be sufficient for 2S engines.
- A 2S engine has less maintenance cost since it has less number of moving parts.
- Since the engine is light in weight and its speed is high, 2S engines are preferred in motor cycles, scooters etc.
- Since there are 2S per cycle, the frictional losses are less.

Disadvantages of 2S engine over a 4S engine:

- Since the firing takes place in every revolution, the time available for cooling will be less than a 4S engine, which results in overheating of the piston and other engine parts.
- Incomplete scavenging results in mixing of the exhaust gases with the fresh charge which will dilute it, hence less power output and low thermal efficiency.
- Since the transfer port is kept open only during a short period, it is likely that less quantity of the charge may be admitted into the cylinder which will reduce the power output.
- Since both the exhaust and the transfer ports are kept open during the same period, there is a possibility of the escape of the fresh charge through the exhaust port which will also reduce its thermal efficiency.
- A 2S engine needs better cooling arrangement because of high operating temperature.
- A 2S engine consumes more lubricating oil.