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Internal Assessment Test 1 – Sept. 2017

Sub:	Elements of Mechanical Engineering					Sub Code:	15EME14	Branch:	ME,EEE,ECE
Date:	20/09/2017	Duration:	90 min's	Max Marks:	50	Sem / Sec:	1st , ALL		OBE

PART – A: [Answer any 4 questions]

		MARKS	CO	RBT
1	**Define:** (i) Brake Power (ii) Thermal Efficiency (iii) Ice Making Capacity (iv) Ton of Refrigeration (v) Coefficient of Performance (vi) Refrigeration (vii) Air Conditioning (viii) Friction Power (ix)Refrigerating Effect (x) Scavenging	[10]	CO2 & CO6	L1
2	With a neat sketch, explain construction and working of vapour absorption refrigeration system.	[10]	CO6	L2
3	Explain the construction and working of a 2 stroke petrol engine with the help of neat sketches. Draw its PV diagram.	[10]	CO2	L2
4	With the help of neat sketches explain the working of a 4 stroke constant pressure heat addition cycle engine. Also draw its PV diagram.	[10]	CO2	L2
5	Differentiate between [any two]: (a) petrol and diesel engine, (b) 2 stroke and 4 stroke engine, and (c) vapour compression and vapour absorption refrigeration system	[5+5]	CO2 & CO6	L2
6	With a neat sketch explain window type air conditioning process	[10]	CO6	L2

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PART – B: [Answer any 1 question]

7	A single cylinder 4 – stroke engine has a swept volume of 4.5litres. The mean effective pressure is 0.65MPa and the engine speed is 505rpm. If there are 250 explosions per minute and the brake torque is 176Nm, find indicated power and brake power of the engine.	[10]	CO2	L4
8	The following observations were made during a trial run on a single cylinder 4 – stroke cycle oil engine: Stroke = 300 mm, Bore = 200 mm, Piston Speed = 3.5 m/s, Torque = 630 Nm, Mechanical efficiency = 85%, Indicated thermal efficiency = 30% and Calorific value of the fuel = 43,900 kJ/kg. Calculate the mean effective pressure and mass of fuel consumed per hour.	[10]	CO2	L4

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Solution of Internal Assessment Test

Sub: EME. PART-A. Sub Code: 15EME14

Q1 Define

(i) Brake power: It is the power developed by the Engine at the output Shaft i.e the net power available at the Crank Shaft i.e the power developed inside the Cylinder is transmitted to the Crank Shaft through the piston, Connecting rod and the Crank Hence a fraction of the indicated power developed inside the cylinder is lost due to the friction of moving parts, hence the net power available at the Crank Shaft for doing useful work is always less than indicated power.

$$B.P = \frac{2\pi NT}{60 \times 1000} \text{ K.W.}$$

N = The Engine Speed in Rpm,

T = Torque in Nm.

(ii) Thermal Efficiency: It is defined as the ratio of power output to the heat Supplied by the Combustion of the fuel.

$$\eta_{th} = \frac{\text{power O/P}}{m_f \times C.V} \times 100\%$$

here m_f is the mass flow rate of the fuel in kg/sec.
C.V is the Calorific Value of the fuel in KJ/kg.

(iii) Ice making capacity: It is the ability of the refrigerating System to produce Ice from water at room temperature.

(iv) Ton of Refrigeration: It is defined as the quantity of heat absorbed to produce one ton of Ice in 24 hrs from water at 0°C.

1 ton = 907.18 kg

(v) Co-efficient of performance: It is defined as the ratio of the heat removed from the System to the amount of work input giving to the System to produce that effect.

$$COP = \frac{\text{Amt of heat removed}}{\text{Amt of work input}} \quad \frac{KJ/S}{KJ/S} = \frac{Q}{W}.$$

(vi) Refrigeration: It is defined as the process reducing the temperature of Substance below the Surrounding atmosphere with the help of Some external work.

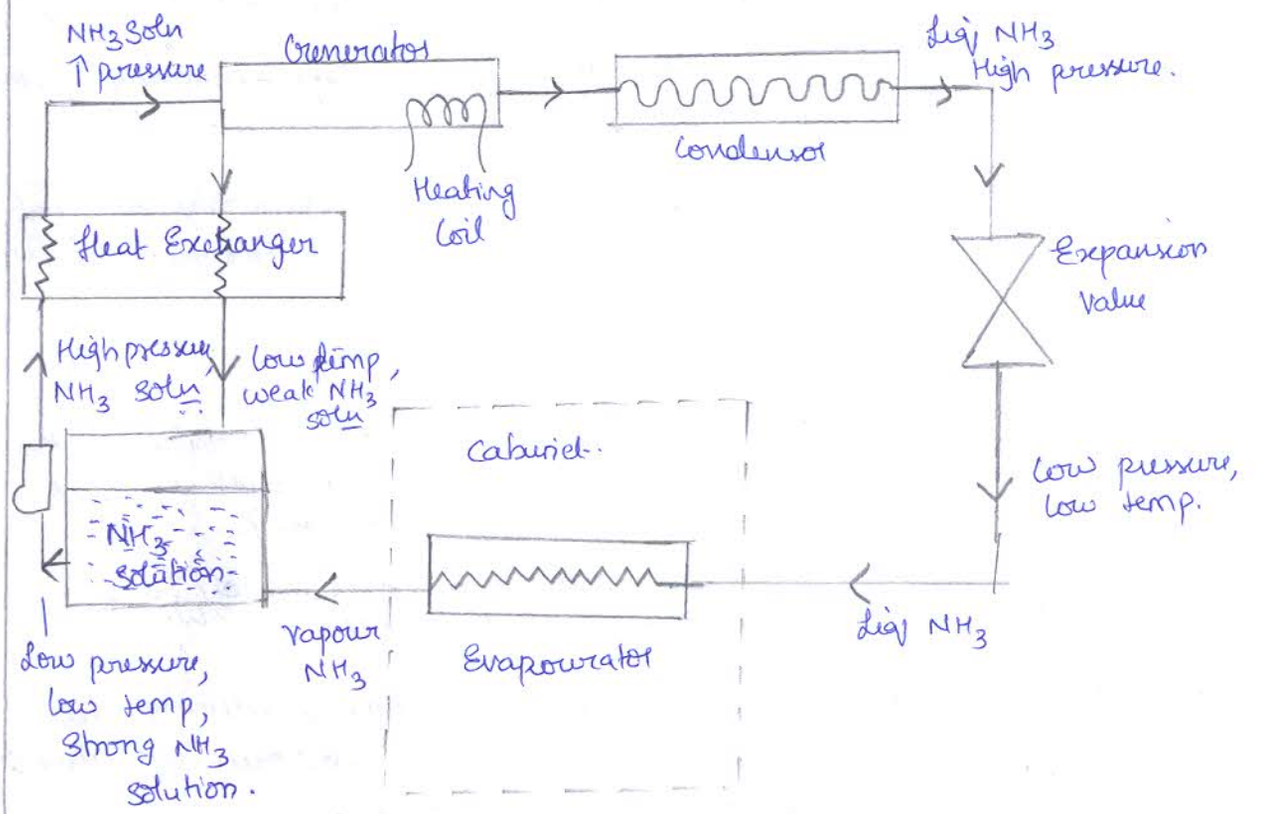
vii) Air Conditioning: It is defined as the process of Simultaneous control of temperature, humandity, cleariness, and air motion of a confixed Space.

iii) Friction power: The amount of power lost due to the friction of the moving parts in the Engine is called as the friction power.
$F.p = I.p - B.p$ kw.

ix) Refrigerating Effect: It is the amount of heat removed per unit time from the Space to be cooled by the refrigeneration process.
Express in terms of kW / kJ / sec.

x) Scavenging: The charge entering the cylinder of two Stroke Engine drives aways the remaining exhaust gases through the exhaust-port in the 1st Stroke.
The process removing the burnt gases or charge out of the cylinder with the help of fresh charge entering into the cylinder is called Scarvenging.

2) With a neat Sketch, explain Construction and working of vapour absorption refrigeration System.



i) A vapour absorption System make 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 to a liquid, and Subsequently give off its vapours when heated.

ii) water which has this ability is the most by used absorbend, Since ammonia readily dissolves in water and Vapourises when its Solution is heated is the Commonly used refrigerant in the Vapour absorption refrigerator.

Working.

i) Dry ammonia Vapour is dissolved in the Cold water Contained in the absorber, which will produce a Strong ammonia Solution.

ii) 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 flowing back from the heater - Separator.

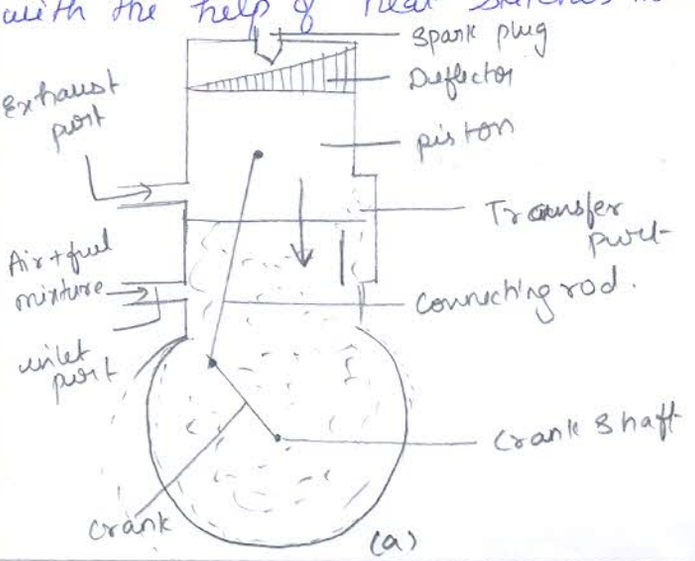
iii) Heating of the high pressure Strong ammonia Solution will drive out the ammonia Vapours from it.

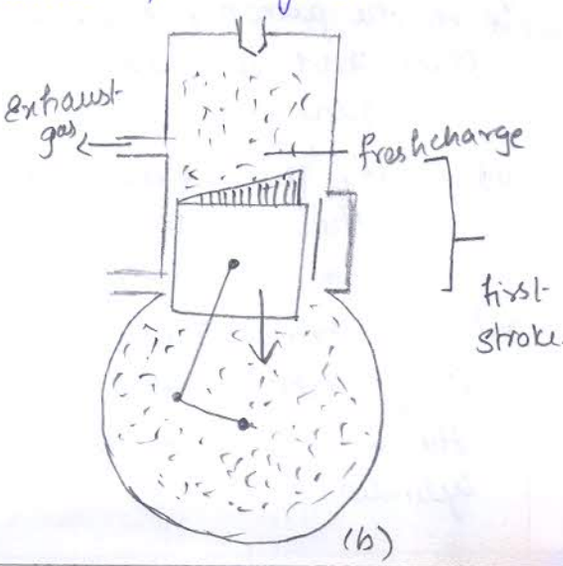
iv) The high pressure ammonia Vapour from the heater - Separator now passes to a Condenser, where it is condensed.

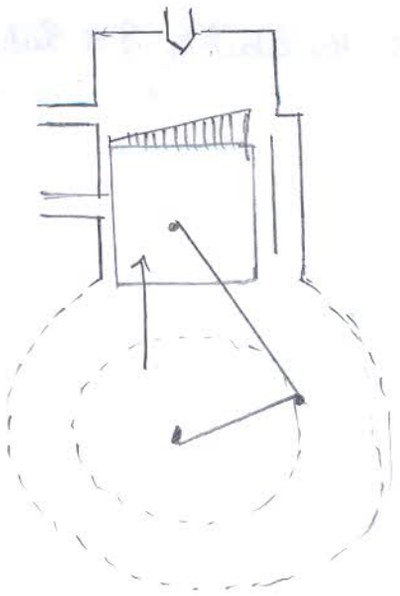
v) The high pressure ammonia liquid is now expanded to a low pressure and low temperature in the expansion Valve.

vi) The low pressure Condensed ammonia liq at low temperature is passed onto the evaporator Coils provided in the freezing Compartment, where it absorbs the heat and evaporates.

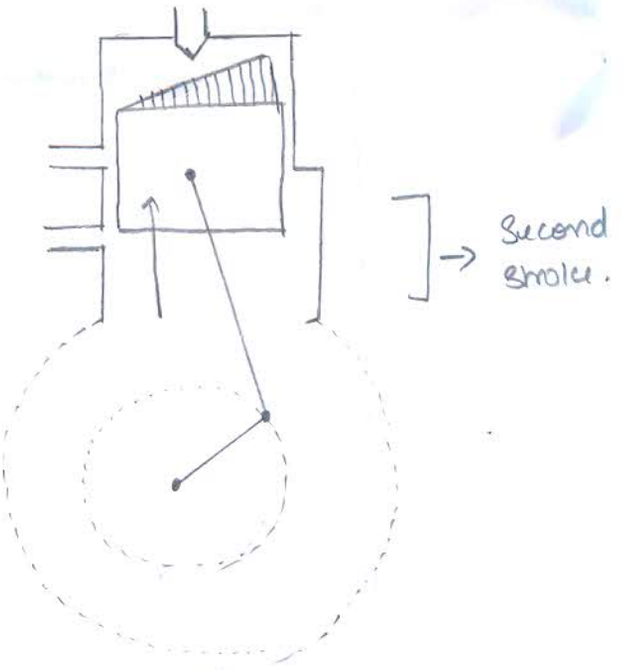
3) Explain the Construction and working of a 2 Stroke petrol engine with the help of neat Sketches. Draw its PV diagram.







(c)



(d)

First Stroke / Downward Stroke:

i) At the being of this Stroke, the piston is at the TDC as Shown in figure a. At this position the inlet port is opened and hence, the fresh air fuel mixture is entered into the Crank Case.

ii) At the position Compress air fuel mixture present in the cylinder from the previous cycle is ignited by a Spark generated by the Spark plug.

iii) The Combustion of fuel releases hot gases which increases the pressure inside the cylinder, Volume remaining Constant, the high pressure burnt gases exerct a thrust on the piston and hence; it moves from TDC to BDC. Thus the Expansion occurs and hence it perfoems the power Stroke.

iv) The power developed in transmitted to the Crank Shaft from the piston through the Connecting rod and thus work is obtained

v) As the piston moves downward further the transfer port open and the fresh charge enters into the cylinder as Shown in figure b.

vi) As the piston moves downward further the transfer port open and the fresh charge enters into the cylinder from the Crank case. through the transfer port. as Shown in figure.

vii) The piston is provided with a deflector whose purpose to deflect the fresh charge coming top end of the cylinder. By doing this the fresh charge desires the entire Burnt charge out of the cylinder.

Second Stroke / upward Stroke:

i) At the being of the Stroke, the piston is at BDC and it covers the inlet port as shown in figure c and stops the flow of fresh charge into the Crank Case.

ii) During a Stroke the piston Starts moving from the BDC to the TDC. As the piston moves upward it closes the transfer port, thereby Stopping the flow of freshcharge into the Cylinder.

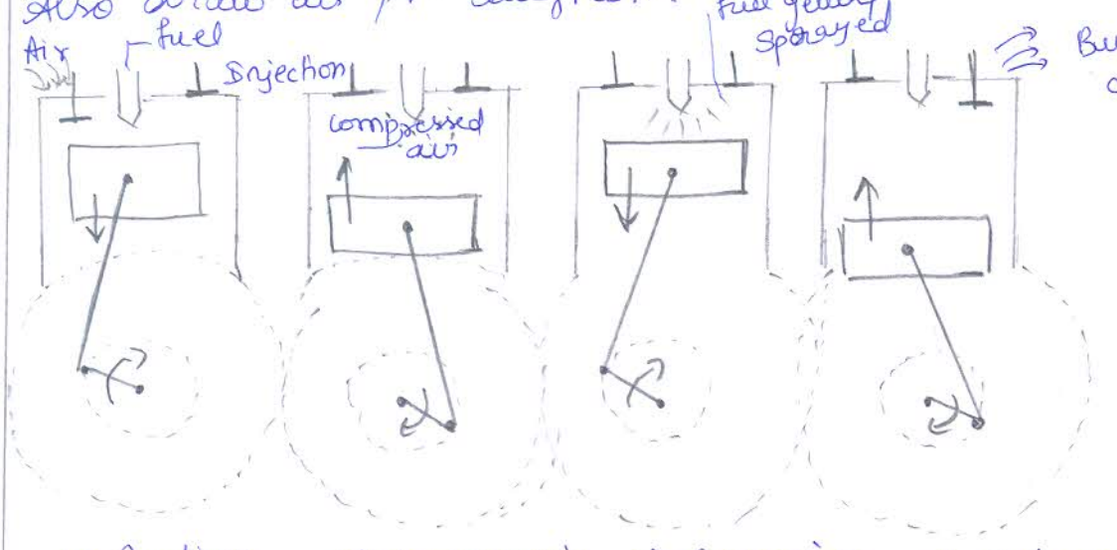
iii) Further upward movement of the piston closes the exhaust port and the Compression of the charge inside the Cylinder being.

iv) In the mean time, the inlet port is opened and the upward movement of the piston Creates a Suction force inside the Crank Case. which draws the fresh charge.

v) The Compression of the charge in the Cylinder Continues till the piston reaches TDC thereby completing one cycle of operation.

vi) Hence a two Stroke Engine develops power by two Stroke of the piston or one revolution of the Crank Shaft.

4) With the help of neat Sketches Explain the working of a 4 Stroke Constant pressure heat addition cycle Engine. Also draw its pv- diagram.



a) Suction Stroke b) Compression Stroke c) Expansion Stroke d) Exhaust Stroke.

i) Suction Stroke:

a) The Suction Stroke Starts when piston is in TDC and about-to move downwards

b) The Crank Shaft revolves, either by the momentum of the flywheel or by the electric motor to move the piston to BDC

c) IV is open and EV is closed.

d) Due to the Suction Created by the downward motion of the piston only air from the atmosphere is drawen into the cylinder

ii) Compression Stroke:

a) Inlet & Exhaust Values remain closed.

b) The piston Starts to return from BDC to TDC by the Compressing the air with decrease in Volume and increase in pressure.

c) Just before the end of the Stroke, the end fuel injector opens and a fine Spray of fuel is injected into the hot Compressed air, when it Starts burning with the pressure maintained exhaust.

iii) Expansion Stroke:

a) Both inlet & exhaust Value are Still closed.

b) The hot gases and air exert pressure on the piston and pushes it from TDC to BDC.

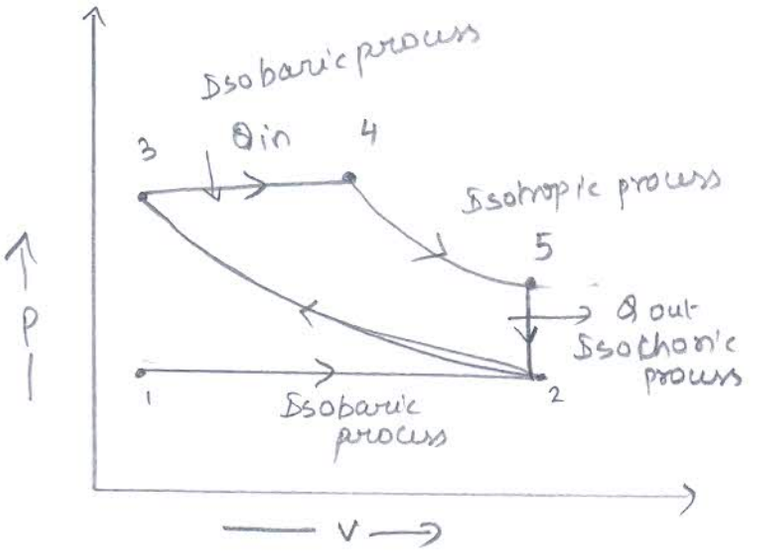
c) At the end of the Stroke, the exhaust Value opens and hot gases are discharge into the atmosphere

iv) Exhaust Stroke:

a) The inlet Value remains closed.

b) The piston returns from BDC to TDC & tries to push the remaining burnt gas to the atmosphere at Constant pressure with ↓ in Volume.

c) At the end of the Stroke, the exhaust Value closes and Small quantities of gases get trapped in the Clearance Volume. And they are ready for next cycle.



5) Differentiate between
(a) petrol & diesel engine.

S.NO	Description	Petrol	Diesel.
1.	Basic cycle of operation	It works on otto cycle or constant volume heat addition cycle	It works on Diesel cycle or constant pressure heat addition cycle.
2.	Fuel	It is gasoline / petrol	It is diesel.
3.	Admission of fuel	A gaseous mixture of fuel and air is introduced during the suction stroke	fuel is injected directly into the combustion chamber at high pressure at the end of the combustion stroke.
4.	Compression ratio	Low. 6:1 to 10:1	high 16:1 to 20:1

5.	Thermal efficiency	The Thermal efficiency of Petrol Engine is low due to low compression ratio	The Thermal efficiency of diesel Engine is high due to higher compression ratio.
6.	Mechanical efficiency	Mechanical efficiency ↑ has the Compression ratio and the peak pressure are less	It is less because of higher Compression ratio and the peak pressure
7.	Operating Cost	The operating cost is high as the fuel is costly	The operating cost is low as the fuel is Cheaper.
8.	Maintance Cost	less	more
9.	Engine Speed	high Engine Speed of about 3000 rpm due to light weight and Homogeneous combustion	low Engine Speed of about 500 rpm to 1500 rpm. It is Heterogeneous combustion
10.	Uses	Scooters, motor, cycle car etc	trucks, Buses, trains etc.

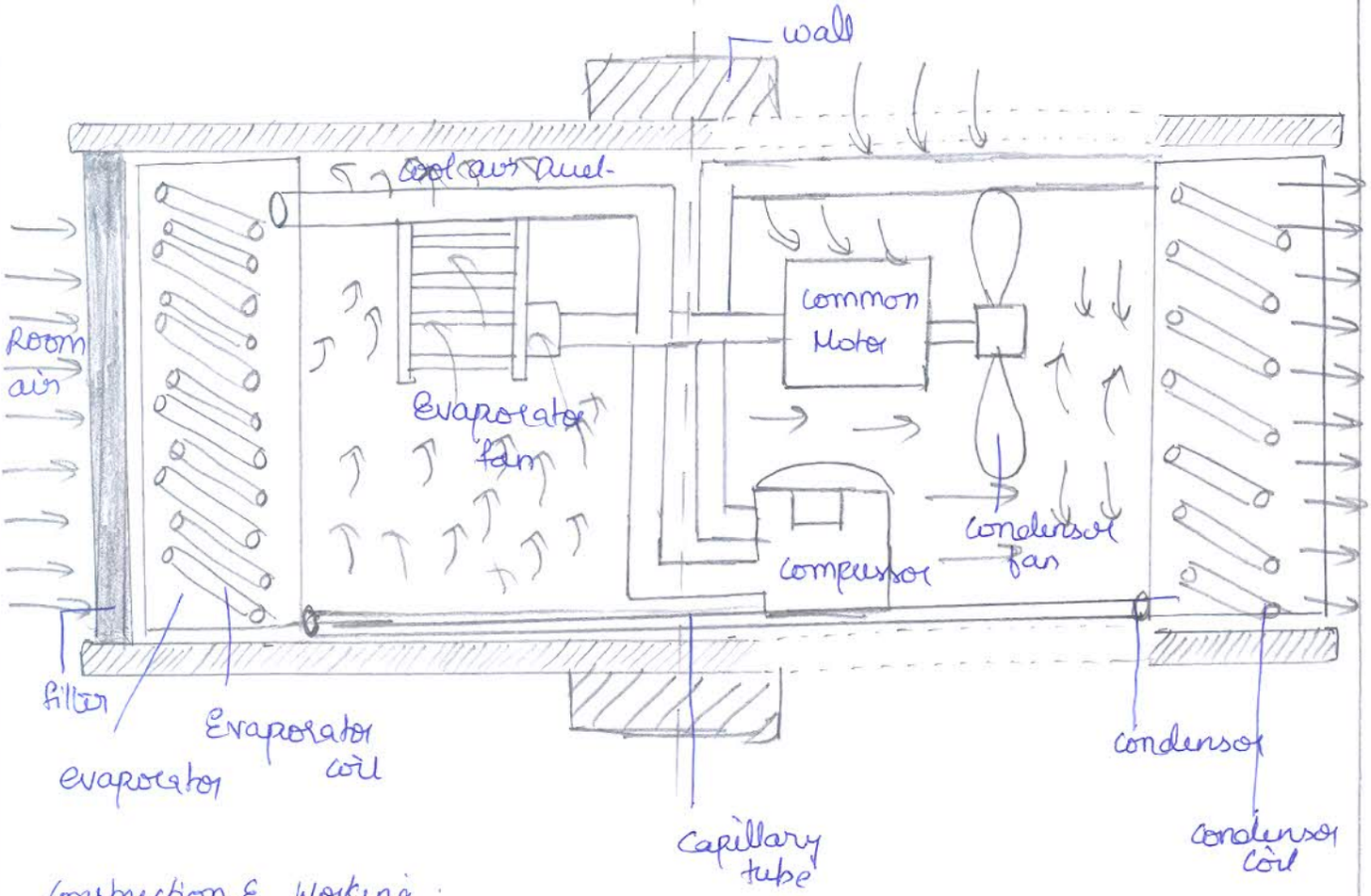
(b) 2 Stroke and 4 Stroke.

S.NO	Description	4- Stroke Engine	2- Stroke Engine
1.	Cycle of operation	One cycle is completed in 4 Stroke of the piston/ two revolution of the Crank Shaft	It is completed in 2 Stroke of the piston or One revolution of the Crank Shaft.
2.	Power Stroke	one power Stroke is obtain-ed in every 2 revolut-ion of Crank Shaft	one power Stroke is obtained in each revolution of the Crank Shaft.
3.	Value mechanism	They have Valves and Value actuating mechanism for opening and closing which is controlled by Cam Shaft.	There are no Values and no Cam Mechanism It has ports (Inlet, Exhaust and transport port).
4.	Weight	It is heavier because of its design	It is lighter because of its design
5.	Initial Cost	higher because of its heavier weight	low because of its Simple design.
6.	Cooling System	Since the power is developed in the alternate revolution of the Crank Shaft	Since the power is developed in every revolution of Crank Shaft
7.	Fuel Consumption	Fuel Consumption is less Since there is no mixing of the fresh charge with the burnt charge	Since there is mixing of the fresh charge and burnt charge, therefore fuel Consumption is high.
8.	Application	used where efficiency is important Ex: Car, industrial, Engines etc	used where low cost Compactness. Ex: Hand Spraying

(c) Vapour compression and vapour absorption refrigeration System.

S.No	Discription	Vapour Compression Refrigerating System	Vapour Absorption Refrigerating System
1.	Energy utilized	Works on mechanical Energy	It works on heat Energy.
2.	Capacity	Maximum capacity is 1000 tons	Maximum capacity is above 1000 tons.
3.	Cop (co-efficient of performance)	The cop of Vapour Compression System decreases with increases in load	At reduce loads the absorption System is almost as efficient as in full load condition
4.	Energy Consumed	Mechanical energy required is more because refrigerera-ti Vapours are to be Compressed to high pressure	Since a pump is required only to circulate the refrigerent the energy required to run the pump is less
5.	Working method	The refrigerate vapour is Compressed	the refrigerate Vapour is absorbed and heated.
6.	Maintainance cost	Maintainance cost is more due to the compressor	Due to the absence of moving the maintainace cost is less.
7.	Refrigerate	fron-12	Ammonia.
8.	Noise	Noisy due to the presence of compressor	There are no moving parts in the entire absorption System hence the operation is high.

6) With a neat Sketch Explain window type air conditioning process.



Construction & Working:

It is designed to condition the air in an individual room. Here the A.C unit is installed in the window or in an opening in the wall. Its main components are:

(i) Condenser, Compressor, Air filter, Drier, Capillary tube, Evaporator fans, Thermostat, Motor and Heaters etc.

(ii) Evaporator unit is inside the room and the condenser part projecting outside the building.

(iii) The high pressure, low temperature liquid refrigerant from the Condenser is passed to the evaporator coils through the capillary tube where it undergoes expansion.

(iv) The low-pressure, low-temperature liquid refrigerant passes through the evaporator coils.

(v) The evaporator-fan continuously draws the air from the interior space with in the room through an air filter by forcing it to pass over the evaporator coils.

(vi) The air from the interior passing over the evaporator coils is cooled by the refrigerate which consequently evaporates by absorbing the heat from the air.

(vii) The high temperature evaporated refrigerant from the evaporator is drawn by the section of the compressor which compresses it and delivers it to the condenser.

(viii) The high pressure, high temperature refrigerant vapour now flows through the condenser coils.

(ix) The high pressure, high-temperature refrigerant passing inside the condenser coils condenses by giving off the heat to the atmospheric air.

(x) The cooled high pressure refrigerant from the condenser passes through the capillary tube where it undergoes expansion and is again re-circulated to repeat the cycle continuously.

PART-B

7) A single cylinder 4-stroke engine has a swept volume of 4.5 litres. The mean effective pressure is 0.65 MPa and the engine speed is 505 rpm. If there are 250 explosions per minute and the brake torque is 176 Nm, find indicated power and brake power of the engine.

Ans: Given:

4 stroke.

$V_s = 4.5\ l$.

$P_m = 0.65$ MPa.

$N = 505$ rpm.

$T = 176$ Nm

$I.P = ?$, $B.P = ?$

$LA = 4.5$ litre

$= 4.5 \times 1000\ cm^3$

$= 0.0045\ m^3$

$I.P = \frac{P_m LAn}{60}$ W

n = number of cycle per min

$\frac{N}{2}$ for 4 stroke.

$\therefore \frac{505}{2} = 252.5$ cycle/min

$I.P = \frac{P_m LAn}{60}$ W

$= \frac{0.65 \times 10^6 \times 0.0045 \times 20}{60 \times 1000}$ kW

$= 12.18$ kW.

$$B.P = \frac{2\pi NT}{60} \text{ W}$$

$$= \frac{2 \times \pi \times 505 \times 176}{60 \times 1000} \text{ kW}$$

$$= 9.3 \text{ kW}$$

8) The following observation were made during a trial run on a Single cylinder 4 - Stroke cycle oil engine. Stroke = 300mm, Bore = 200mm, Piston Speed = 3.5 m/s, Torque = 630 Nm, Mechanical efficiency = 85%, Indicated thermal efficiency = 30% and CV is 43,900 KJ/kg.

Calculate Pm and mf.

Given:

$n = 1$

$N = \frac{N}{2}$

$L = 300\text{mm} = 0.3\text{m}.$

$d = 200\text{mm} = 0.2\text{m}.$

$T = 630 \text{ Nm}$

$\eta_{mech} = 85\% = 0.85$

$\eta_{ith} = 30\% = 0.3$

$CV = 43900 \text{ KJ/kg}$

find

$P_m = ?$

$m_f = ?$

$$S_p = \frac{P_m \times A \times L \times N \times n}{2 \times 60 \times 100}$$

$$\eta_{mech} = \frac{B.P}{I.P}$$

$$B.P = \frac{2\pi NT}{60 \times 1000} \text{ kW}$$

$N = ?$

$$S_p = 2 \times L \times N$$

$$3.5 = 2 \times 0.3 \times N$$

$$N = 350 \text{ rpm}.$$

$$B.p = \frac{2 \times 3.14 \times 5.833 \times 630 \times 60}{60 \times 1000}$$

$$B.p = 0.38 \text{ kw} \times 60$$

$$= 22.8 \text{ kw}$$

$$I.p = \frac{22.8}{0.85}$$

$$= 26.8 \text{ kw}.$$

$$26.8 = \frac{Pm \times (3.14) \times (0.2)^2 \times (0.3) \times 350}{60 \times 1000}$$

$$Pm = \underline{\underline{0.987 \times 10^6}} = 9.87 \text{ bar}.$$

$$Mith = \frac{I.p}{mf \times CV} \times 100\%$$

$$0.3 = \frac{26.8}{mf \times 43900}$$

$$mf = \underline{\underline{2.0615 \times 10^{-3} \text{ kg/s}}}.$$