Assignment - 1

Q.1 Define thermodynamics. Explain open system, closed system and isolated system.

Ans Thermodynamics is the branch of science that deals the transfer of energy and its effect on physical properties of substance. It is the relationship between heat, energy and work.

Classification of system :-

(i) Closed system :- A system in which mass is fixed and energy may be transfered from system to surrounding is known as closed system.

Ex :- A cup of coffee with a lid on it, piston cylinder without valve.

(ii) Open system :- A system that allows both mass and energy transfers across the boundaries it called open system.

Ex:- A cup of coffee without lid, Air Compressor

(iii) Isolated system :- There is no interaction between system and surrounding is known as isolated system.

Ex :- Thermoflask

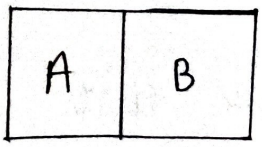
If neither mass nor energy cross the boundary of a system it is called an isolated system.

Q:- Explain the laws of thermodynamics and gas laws of thermodynamics.

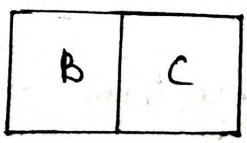
Ans Laws of thermodynamics :-

(i) Zeroth law of thermodynamics :-

→ If system 'A' is in thermal equilibrium with system 'B' and system 'B' is also in thermal equilibrium with system 'C' Then acc. to zeroth law of thermodynamics system 'A' and system 'C' be in thermal equilibrium.

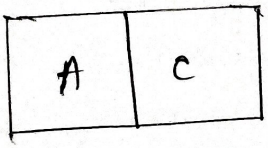


if $T_A = T_B$



& $T_B = T_C$

then concept of thermodynamics zeroth laws says



Hence $T_A = T_C$

Zeroth law is the basis of temp. measurement.

(ii) first law of thermodynamics :-

→ When a system operating in a cycle the net heat supplied to the system from the surroundings is equal to the net workdone on the surroundings.

$$\oint d\theta = \oint dw$$

$$\Delta V = Q - W$$

where ΔV = change in internal energy

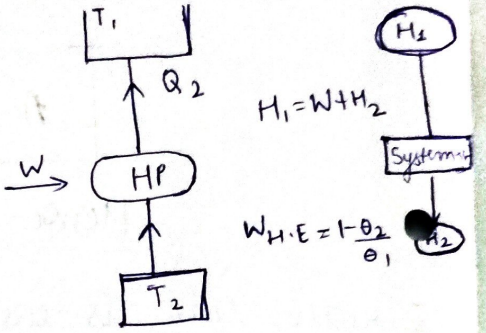
Q = Heat added to the system

W = Work done by the system.

* (iii) Second law of thermodynamics

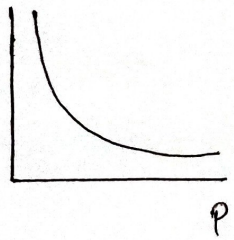
→ It is impossible to construct a device operating in a cycle where heat transfer is from cooler body to hotter body without any external work.

No system is 100 % efficient



Gas law of thermodynamics :-

(1) Boyle's law ($V \propto \frac{1}{P}$) ⇒ If the temperature of a gas remains constant, the volume of a gas is inversely proportional to the pressure.



$$V \propto \left(\frac{1}{P}\right)_{\text{constant}}$$

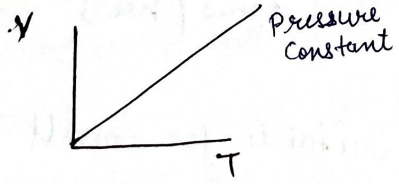
or $V = \frac{C}{P} \Rightarrow PV = C$

or $P_1V_1 = P_2V_2$

② Joule's law : Internal energy is a function of temperature only. It means the internal energy of an ideal gas doesn't change if volume and pressure changes (but does not changes if temperature changes).

③ Charle's law :- ($V \propto T$ at constant P)

Charles law is state that when any gas is heated at constant pressure the volume of a gas is directly proportional to absolute temp.



$V \propto T$ at P constant

$V = KT$

$\frac{V}{T} = K$

$= \frac{V_1}{V_2} = \frac{T_1}{T_2}$

④ Gay - Lussac's law :- ($P \propto T$) at (V = constant)

The pressure exerted by a gas is proportional to the temp. of the gas when volume is constant.

$P \propto T$ at V constant

$\left(\frac{P}{T}\right) = K$

Thus, an ideal gas always obeys the perfect gas equation as follows

$$PV = nRT$$

Q.3 What are differences b|w fire tube and metal tube boilers.

ans

Water Tube	Fire Tube
1. Water is inside the tube and fire gases surrounding to it.	The gases inside the tube and water surrounded to it
2. Operating pressure is up to 165 bar (high pressure boilers).	operating pressure is up to 25 bar (low and medium pressure boilers).
3. Steam generation rate is very high (more than 450 tones/hr)	Less steam generation rate (9 tones/hr)
4. Suitable for power plant.	Suitable for small industry.
5. Chance of explosion is more due to high steam pressure.	Chance of explosion is less due to low steam pressure.
6. Provide steam in power plants to develop electrical energy.	Provide steam in chemical and pharamceutical industries.
7. Small chance of scale formation due to the flue gases are in shell.	More chance of scale formation.
8. Operating cost is high less floor area is required.	Operating cost is low more floor area is required.

Ex:- babcock and wilcon boiler	Ex:- vertical locomotive.

Q.4 what are the diff. between impulse & Reaction impulse turbines?

ans

Impulse	Reaction Impulse
1. It consists of nozzles and moving blades	It consists of blades which acts as nozzles and moving blades.
2. Steam is expanded Completely in the nozzle. All the potential energy is converted into K.E.	Steam is partially expanded in the fixed blades. Some amount of PE is converted into K.E.
3. Potential of steam is Constant over the moving blades.	Potential drops takes place in moving blades.
4. Because of high potential drop in the nozzles blade speed and steam speed are high.	Because small potential drop, blade speed & steam speed are less.
5. Low efficiency	High efficiency
6. Occupies less spaces per unit power.	occupies more space per unit power.

Q.5. What are steam boiler ? State some application of steam boilers.

ans A steam boiler or generator is defined as a closed vessel in which water is converted into steam by burning fuel in presence of air at desired temperature, pressure and at desired mass flow rate.

Applications :-

1. used in steam turbines to develop electrical energy
2. Used to run steam engines.
3. In textile industries, sugar mills or in chemical industries is a co-generation plant.
4. Heating the buildings rooms in cold weather.
5. Producing hot water for hot water supply.

Q.6 Give three examples each of boiler mountings and boiler quessories.

ans Mountings :-

1. Safety valves
2. Water level indicator
3. Pressure gauge

Accessories :-

1. Feed pumps
2. Injector
3. Economiser

Q.7 What are the main parts of a steam turbine? What is the function of a steam nozzle.

Ans Steam turbine is one of the most important prime mover for generating electricity. This faces under the category of power producing turbomachine.

Main parts :-

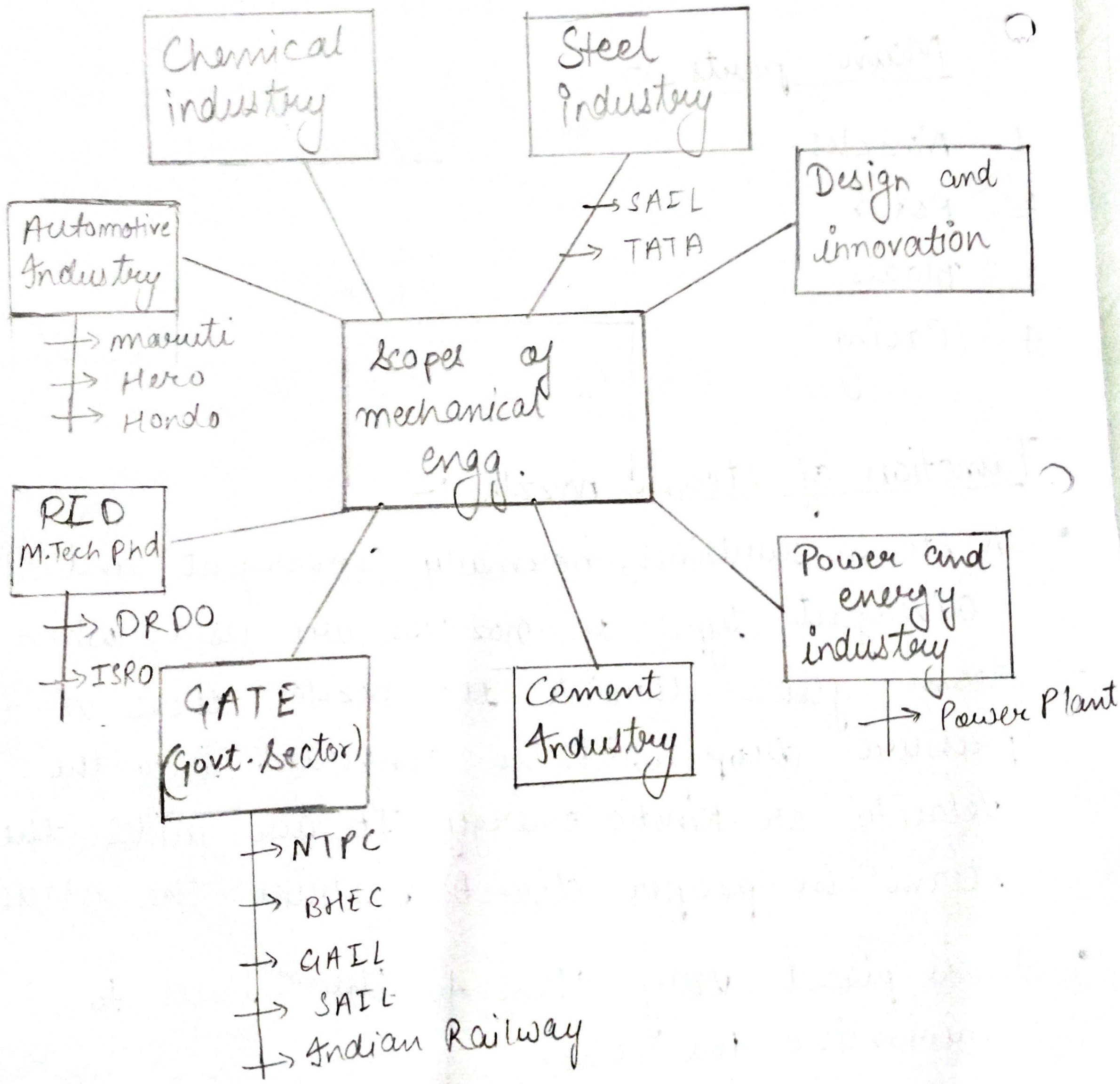
1. Nozzles
2. Rotor
3. Blades
4. Casing

Function of steam nozzles :-

- In steam turbines, normally convergent and divergent types of nozzles are used. when the steam flows through the nozzles there is a pressure drop which is converted into the velocity or kinetic energy. It also guides the steam in proper direction strike the blades.
- It is placed very close to the blades to minimize the loses.

Q. 8 Define mechanical engineering and its scope.

ans Mechanical engg. is the discipline that applies the concept of engineering physics, engg. mathematics and material science, principles to design analysis, manufacture and maintain mechanical system.



Q.9 Explain the working of steam Power Plant with suitable diagram.

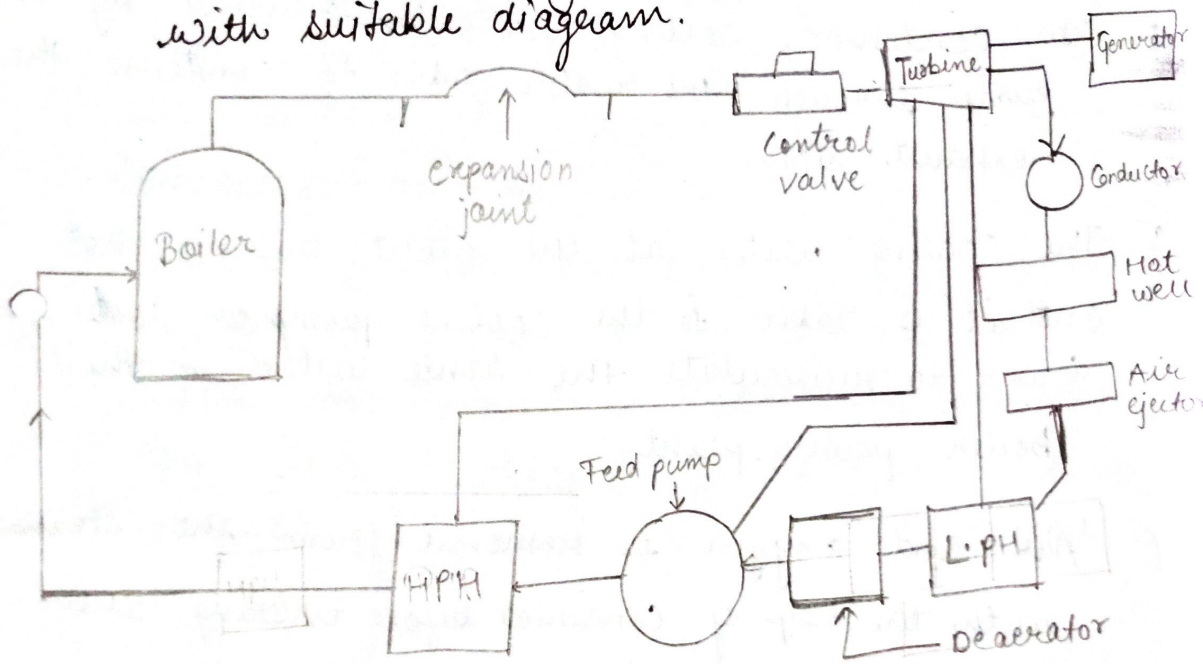


Fig :- Steam Power Plant.

Working of steam Power Plant :-

1. Steam from the boiler is taken to the turbine through which the steam pipe fitted with expansion joint.

2. From the turbine, steam enters a condensor. In the condensor, the exhaust steam from the turbine is condensed ~~into~~ due to which high vacuum

is produced. Due to high vaccum, the power out and thermal efficiency of the turbine is increased.

3. Also the condensed water is also recirculated in the system.

4. In condensor, cooling water is circulated by the pump through the water tubes to condense the exhaust steam.

5. The cooling water at the outlet becomes hot and it is taken to the cooling pump or cooling tower to recirculate the same water in the boiler power plant.

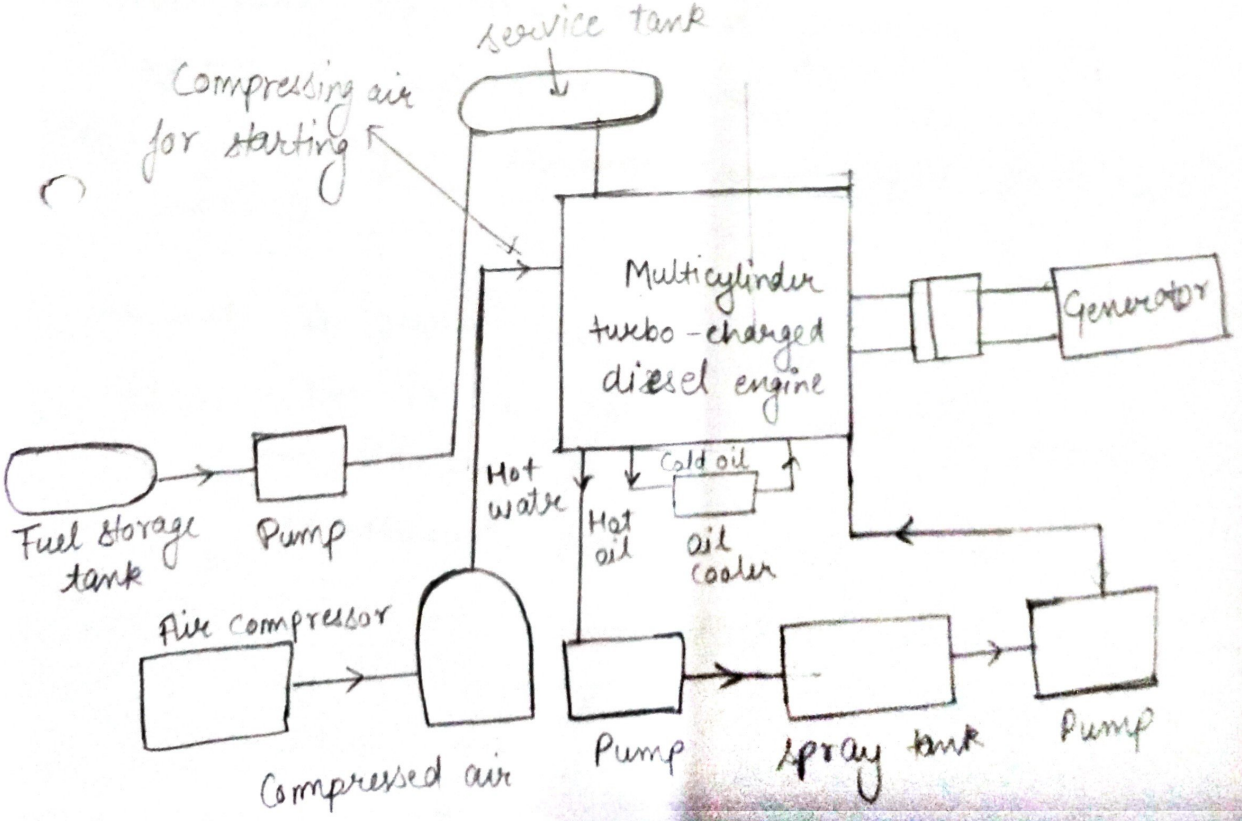
6. Air and oxygen is removed from the steam with the help of condensor before entering the boiler.

7. Pre heating the feed water at different stages using law pressure heater and high pressure water.

Q-10 Explain the working of Diesel Power Plant with suitable diagram.

ans The layout of a diesel power plant is given in fig. 1. Normally, multicylinder 2-stroke ~~atmospheric air~~ is compressed ~~by a compressor~~

turbocharged diesel engines are used in power plants. In a turbocharged engine, the atmospheric air is compressed by a compressor run by an exhaust-driven gas turbine and the compressed air is taken inside the cylinder. Due to this mass of air intake and amount of fuel burnt will be considerably increased giving rise to increased output power and higher thermal efficiency.



Layout of diesel Power Plant

Due to turbo charging the operating temperature of the engine is increased. So, the lubricating oil coming out of the engine should be cooled in an oil cooler. The cooling water from the engines is normally cooled in a spray tank and recirculated. Due to high capacity, the engine is started by using compressed air.

Assignment No. 1

Q1: Describe the classification of IC engines?

Ans: IC engines can be classified as follows:-

1. According to the type of fuel used:-
   a) Petrol engine b) Diesel engine

2. According to the cycle of operation:-
   a) Four stroke cycle engine.
   b) Two stroke cycle engine.

3. According to the cooling system
   a) Air cooled engine
   b) Water cooled engine.

4. According to the charged pressure
   a) Naturally aspirated engine
   b) Supercharged / turbocharged engine for high capacity.

Q2: What is pump? What is priming?

Ans: Pump: It is a device which is having wide application in pumping of water, fuel, chemical, viscous fluid like lubricant.

Priming:- It is the process in which the impeller of a centrifugal pump is fully sub-merged into the liquid without any air trap inside.

Q3: Explain the specific function of fuel pump and injector in diesel pump?

Ans: • Fuel Pump: The pump produces the high pressure necessary for injection, in the order of 100 - 400 bar, depending upon the engine size and the type of combustion chamber used.

It consists of plunger working in a barrel. The plunger is moved up against the action of spring by means of a cam. During the upward movement of the plunger, when the inlet and spill ports are closed, pressure is developed in the fuel and is sent to the injector through a delivery valve.

• Fuel Injector:- The lower portion of the fuel injector is described. The needle valve is kept in the seat by a helical spring. The tension of spring can be adjusted manually by a nut on the top of the injector to vary the pressure of injection.

Fuel under pressure from the fuel pump enters the pressure chamber through the fuel duct. Because of high pressure the needle valve is lifted up against the spring tension.

Q4: We want to discharge water from lower head to a limited height but we need high discharge, so which type of pump we can use explain with proper working.

Ans: For this work we can use centrifugal pump. The main parts of centrifugal pump are:-

1. Impeller
2. Casing
3. Suction pipe fitted with a foot valve (one way valve) and filter, the foot valve will not allow the water to come down.
4. Delivery pipe.

(i) Impeller:- The impeller is a metallic disc fitted with a no. of curved vanes. Initially water will be poured inside the casing and the process is called priming. So, after priming, the impeller will be immersed in water inside the casing. When the impeller is rotated by an electric motor or an engine, it will produce centrifugal force due to which KE or velocity energy will be produced in the water.

2. Casing:- The casing surrounds the impeller. The area between the impeller and casing is gradually increasing till the delivery pipe. Due to the reduction in K.E the pressure energy of water is increased. The following three types of casing are normally used.

- Volute Casing:- The gap between the impeller and casing is increased. However the size of the casing will be small and the cost will be less.
- Vortex Casing:- The space between the impeller and the casing is increased by introducing a circular chamber. As eddies are reduced, the efficiency of the pumps with the vortex casing is increased.
- Casing with Guide Vanes or Diffuser Casing:- The impeller is surrounded by a set of guide vanes or diffuser. The shape of the guide vanes should be carefully designed to ensure that the water flow from the impeller enters the guide vanes without shock. Gradual increase in area of guide vanes reduces the velocity of flow resulting in pressure increase.

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DETAILED LECTURE NOTES

Ques 5: What is the compression ratio? Explain the main component of IC engine?

Ans: The compression ratio is defined as $\frac{Vs+Vc}{Vc}$ where Vs is the stroke volume and Vc is the clearance volume.

- Main Components of IC Engine:-

(i) Cylinder:- The cylinder allows the piston to move to and fro. It is made of cast iron or steel or aluminium alloy.

(ii) Cylinder head:- It is fitted on the top of cylinder. It also accomodates the inlet valve and the spark plug.

(iii) Piston:- It transmits the force exerted by the burning gases to the connecting rod and finally to the crank shaft. The diameter of piston in a large marine engine is about 1m

(iv) Piston Rings:- Two different types of piston rings are housed in the circumferential grooved provided on the outer surface of the piston. The function of the lower rings is to scrap the used lubricating oil into

piston

the crank case. These rings are called scraper rings.

(v) Connecting Rod :- This transmits the force from the piston to the crank shaft. It also helps in converting the reciprocating motion of the piston into the rotatory motion.

(vi) Crank Shaft :- Great care should be taken in the proper design of the crank shaft. The crank shaft is provided with suitable holes to help in the lubrication system.

(vii) Flywheel :- It is mounted on the crank shaft. The flywheel stores the excess energy during the power stroke of the engine and helps the movement of piston during the remaining idle strokes.

(viii) Cams :- Properly designed cams control the opening and closing of the inlet and exhaust valves in the case of four-stroke engines.

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DETAILED LECTURE NOTES

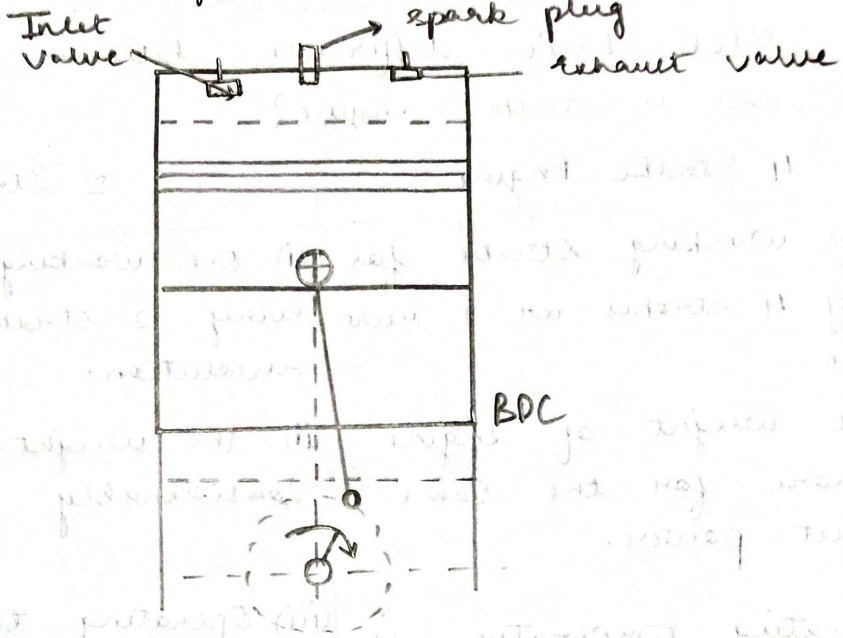
Q6: State basic difference between 2 stroke and 4 stroke engine?

Ans:

4 Stroke Engine	2 Stroke Engine
(i) One working stroke for every 4 strokes or 2 revolution.	(i) One working stroke for every 2 strokes or one revolution.
(ii) The weight of engine is more for the same output power.	(ii) The weight of engine is considerably less.
(iii) Operating temperature is less, so less consumption of oil.	(iii) Operating temperature is more. So, more consumption of lubricating oil.
(iv) Noise is less	(iv) Noise is more due to exhaust.
(v) Higher thermal efficiency	(v) Thermal efficiency is less due to possible wastage of fuel-air mixture.
(vi) Straight piston is used	(vi) Deflector piston is used
(vii) Variation of torque is more	(vii) Smaller flywheel is enough as torque is more uniform.
(viii) Due to valve design of the cylinder head is difficult and cost is more	(viii) Easier in design and the manufacturing cost is less.

Qr: Explain the working of four stroke petrol with neat diagram?

Ans:



(i) Suction Stroke:- Inlet → open, Outlet → close. During this stroke, the inlet valve is kept opened and the exhaust valve is closed. The piston comes down to the bottom dead centre (BDC) from the (TDC). Petrol air mixture in the correct proportion from the Carburetter is drawn inside the engine cylinder through the inlet valve.

(ii) Compression Stroke:- Inlet → close, outlet → close. In this stroke, both the inlet and exhaust valves are kept closed. The mixture of petrol - air is compressed when the

piston moves up to TDC. The compression ratio varies from 7-10 for petrol engines. At the end of the compression stroke, a spark is produced at the spark plug due to which combustion starts resulting in high pressure and temperature which are comparatively less than that of a diesel engine.

(iii) Working or Power Stroke :- Both valve closed during their stroke, both valves are kept closed. The piston is pushed down from TDC to BDC. The force above the piston is transmitted to the crank shaft through the connecting and crank mechanism.

(iv) Exhaust Stroke :- Inlet → close, outlet → open
During the stroke, the exhaust valve is kept opened and the inlet valve is kept closed. The piston moves up from BDC to TDC. The waste gases are sent out through the exhaust valve and the cycle is repeated.

Q8: Differences b/w Petrol and diesel engine:-

Ans:

PETROL ENGINES	DIESEL ENGINES
(i) Compression ratio is 7-10	(i) Compression ratio is 15-20
(ii) Petrol - air mixture is compressed	(ii) Only air is compressed
(iii) Compression pressure is 15-20 bar	(iii) Compression pressure is 30-40 bar.
(iv) Compression Temperature is about 400°C	(iv) Compression temperature is above 500°C.
(v) Peak pressure is in the range of 50-70 bar	(v) Peak pressure is high in the range of 80-100
(vi) Weight of engine is less	(vi) Weight of engine is more.
(vii) Cost of engine is less	(vii) Cost of engine is more
(viii) Due to low peak pressure thickness of parts is less.	(viii) Due to high pressure thickness of parts is more.
(ix) Spark plug is necessary to ignite the fuel - air mixture.	(ix) No need for spark plug as compression temperature is enough to ignite.
(x) Thermal efficiency is low in range of 20-25% due to low compression ratio.	(x) Thermal efficiency is high in range of 25-30% due to high compression ratio.

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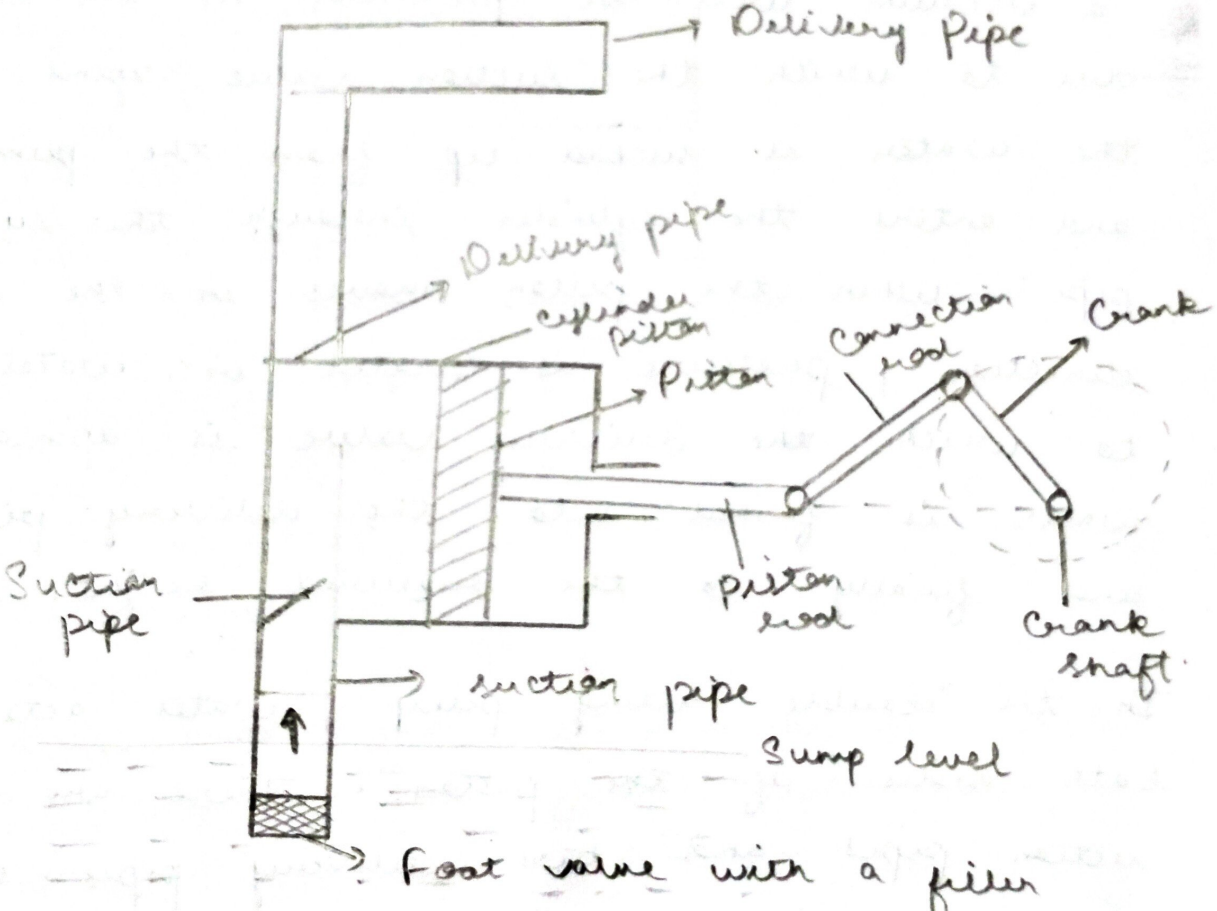
DETAILED LECTURE NOTES

Q9: Explain the working of reciprocating pumps with neat diagram?

Ans: SINGLE - ACTING RECIPROCATING PUMP :-



(i) Cylinder with a piston
(ii) Piston rod, connecting rod, crank and crank shaft
(iii) Suction pipe with a foot valve and filter
(iv) Delivery pipe
(v) Suction pipe

(vi) Delivery pipe.

The crankshaft is coupled to an electric motor or a diesel engine. When the motor or engine is started, the piston moves to and fro inside the cylinder. When the piston moves right in the direction of arrow a vacuum will be produced in the cylinder due to which the suction valve opens and the water is sucked up from the pump and enters the cylinder through the suction pipe. When the piston moves in the left direction, pressure is created in water due to which the delivery valve is opened and water is forced into the delivery pipe and finally to the required height.

In the double acting pump, water acts on both sides of the piston. There are two suction pipes and two delivery pipes. When there is a suction stroke on one side of the piston. Thus, for each revolution of the crankshaft there will be two delivery strokes and so, double the amount of water is delivered by this type of pump.

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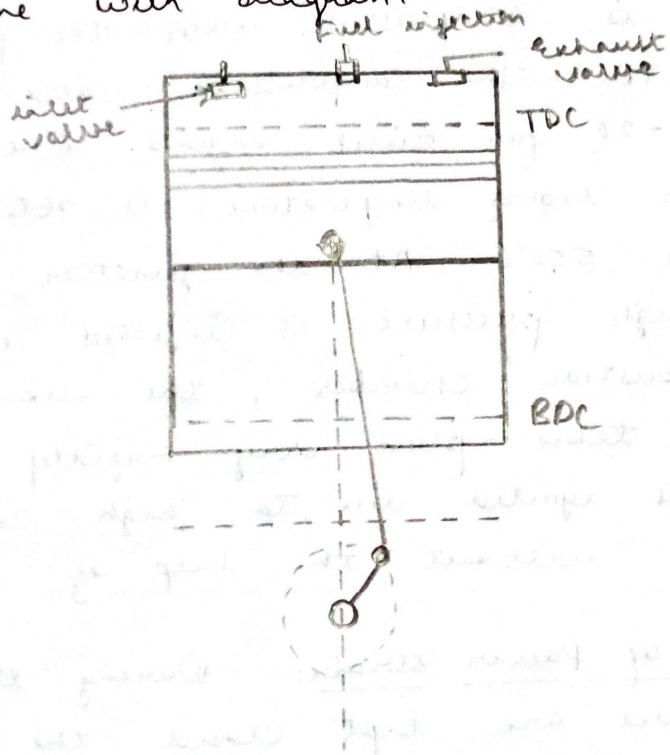
DETAILED LECTURE NOTES

Q10: Explain the working of 4 stroke diesel engine with diagram:-



In diesel engine there is no need of spark plug. Diesel engines are also called compression ignition engines.

1. Suction Stroke:- During this stroke, the inlet valve is kept opened and the exhausted valve is kept opened and the piston comes down to the bottom dead centre from the TDC.

2: Compression Stroke:- In this stroke, both the inlet and outlet valves are kept close The air is compressed when the piston moves up to TDC. The compression ratio moves from 15-20 for diesel engines. Due to high compression higher temperature is obtained in the range 550°C. At the junction diesel oil at a high pressure is injected inside the hot combustion chamber, the mixing of fuel and air takes place very rapidly and the mixture is ignited due to high compression temperature without the help of spark plug.

3. Working of Power stroke:- During this stroke both valves are kept closed the piston is pushed down from TDC to BDC. The force above the piston is transmitted to the crank shaft through the connecting rod and crank mechanism.

4. Exhaust Stroke:- During this stroke the exhaust valve is kept opened and the inlet valve is kept closed. The piston moves up from BDC to TDC. The waste gases are sent through the exhaust valve and the cycle is repeated.

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SESSION 2022-23

Assignment Sheet-1

Campus: PCE Course: B.Tech. **Class/Section: .....** **Date: .....**
Name of Faculty: ..... **Name of Subject: BME** **Code: 1FY3/2FY3-07**
Date of Preparation:..... **Scheduled Date of Submission: .....**

		Marks	CO	BL	PO
Q.1	What is pump? What is priming?	1	CO1	L1	PO1
Q.2	Describe the classification of IC engines?	1	CO1	L1	PO1
Q.3	What are the differences between fire tube and water tube boilers?	1	CO2	L2	PO1
Q.4	What are the differences between impulse and reaction impulse turbine?	2	CO2	L2	PO1
Q.5	State basic difference between 2 stroke and 4 stroke engines.	2	CO2	L2	PO1
Q.6	What are steam boilers? State some applications of steam boilers?	2	CO3	L3	PO1
Q.7	We want to discharge water from lower head to a limited height but we need high discharge, so which type of pump we can use explain with proper working.	2	CO3	L3	PO1
Q.8	What are the main parts of steam turbine? What is the function of steam nozzle?	2	CO3	L3	PO1