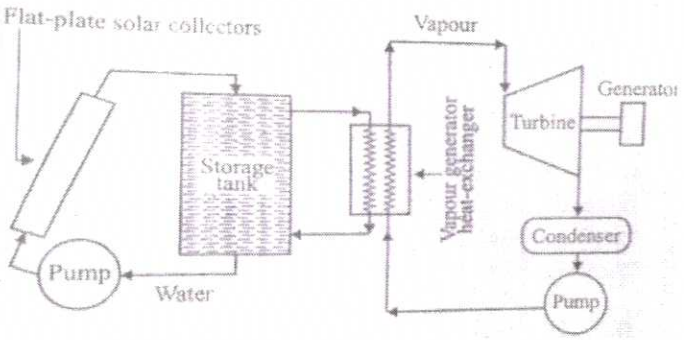
Revision 2015		Course code 2021		
Course title BASIC MECHANICAL ENGINEERING				
Quest. No.	Scoring indicator	Split up score	Sub Total	Total
I				
1.	-Very hard and brittle -Possess poor machinability and weldability (Any Two)	1 1		2
2	Steam above saturation temperature is known as saturated steam	2		2
3.	Valves are present in 4 stroke engine, but ports are present in 2-stroke engine. Heavy flywheel is required in 4 stroke but only lighter flywheel for 2 stroke (any two)	1 1		2
4	Feed pumps,Economiser,superheater etc (Any two)			2
5	1.Danger of nuclear activity 2. Radio active waste disposal (Any two)	1 1		2

II

1



3

6

-Solar radiation tapped using flat plate collector

-Hot water generated is stored in a well insulated container 3

-The hotwater from container is passed through a heat exchanger and working fluid is vapourised

-The vapour runs turbine and coupled to generator to produce electricity

2.

-Economiser is a device used to heat feed water by utilizing the heat in the exhaust flue gases. 2

-It is fitted between boiler and chimney

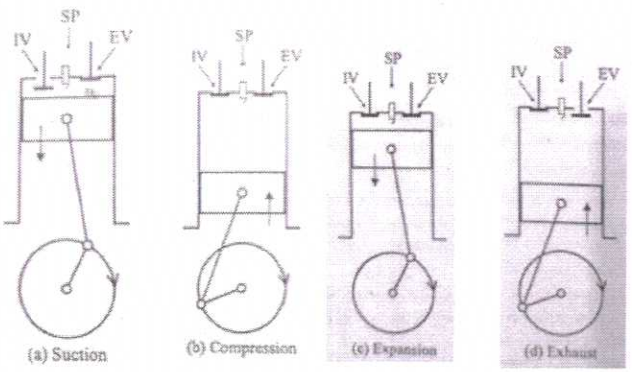
-It consist of two horizontal pipes and number of vertical pipes\ 2 6

-The feed water is pumped into Economiser through bottom horizontal pipe

-The hot water leaves through top horizontal pipe 2

-The water while flowing through vertical pipes get heated by incoming waste flue gases.

3.



3

Suction stroke: Inlet valve opened and air fuel mixture is sucked into the cylinder during the downward movement of piston

Compression stroke: Air fuel mixture get compressed by upward motion of piston. Inlet valve and exhaust valve remains closed

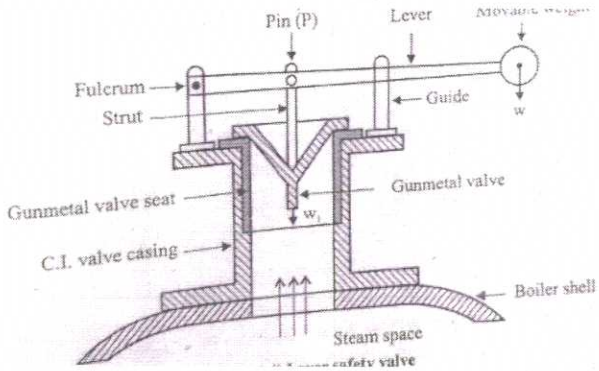
Power stroke: At the end of compression stroke , spark plug initiates a spark and it ignites the air-fuel mixture. The burnt gas drive the piston downwards

Exhaust stroke: Exhaust valve is opened. Inlet valve remains closed. Piston moves upwards and exhaust gas drained out

3

6

4



3

6

-It consist of cast iron valve body fitted to steam space of boiler

-The steam pressure acts on the bottom surface of the valve in vertical upward direction

3

-A lever which carries a movable weight at one end and which is hinged to fulcrum at other end can exert downward thrust

5

Brinnel Hardness Test

2

-Characterize hardness of materials through scale of penetration of indenter

-Larger size of indentation indicates possible damage to testpiece

2

6

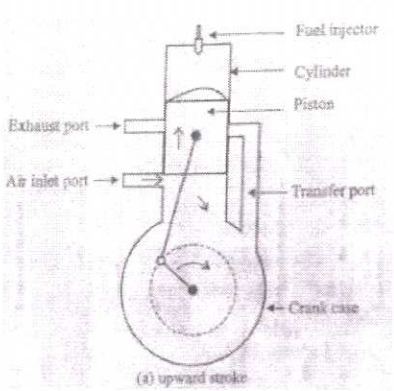
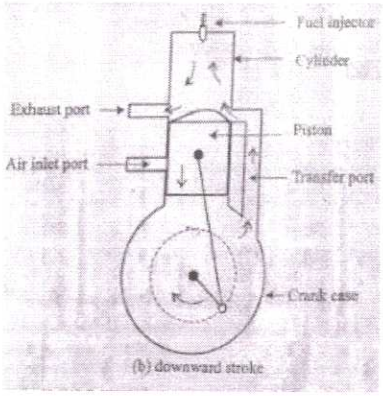
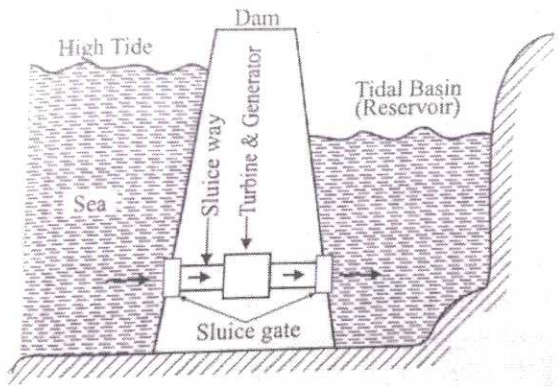
-Indentaion is measured as

$$BHN = \frac{P}{\frac{\pi D}{2}\left[D - \sqrt{D^2 - d^2}\right]}$$

2

Where P = Test load

D = diameter of ball , d = average impression diameter of indentation

6	 	3		6
	1.Upward stroke: During upward movement of piston , inlet port uncovers and suction occurs in the crank case and fresh air enters the crank case. At the same time compression occurs in the cylinder and at the end of the compression fuel is sprayed by injector	3		
	2. Downward stroke: Due to high pressure and temperature generated due to combustion, piston moves downward and power is generated. When power stroke is completed exhaust port uncovers and burnt gas flow out			
7		3		6
	-It consist of Dam, Powerhouse and sluice way			
	-Dam act as a wall to form a reservoir			
	-Power house includes a generator ,turbine and control devices	3		

-A reversible hydraulic turbine coupled to a generator is used in this type of power plant.

-During high tide,water flows from the sea to the basin through the sluice way and drives the turbine. The turbine is coupled to generator and electricity is produced.

PART -C

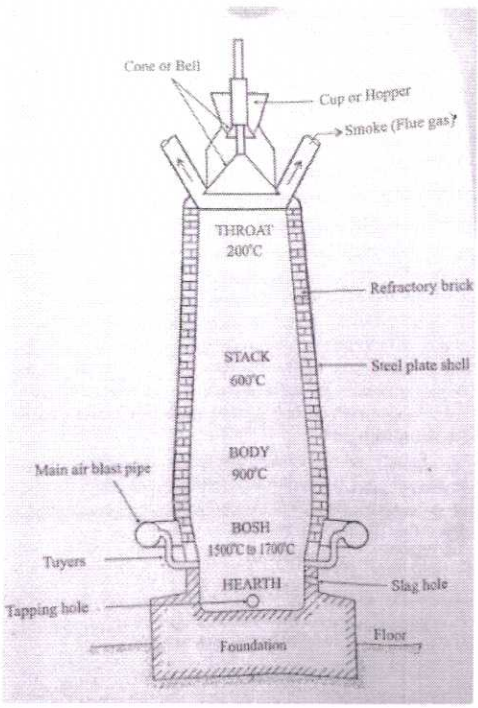
III

a) Any two of

spark test, appearance test, magnetic particle test, liquid penetrant test, ultrasonic test, X-ray radiographic test, gamma ray radiographic test etc

3+4 7

b)



4

-It is a vertical steel vessel lined with refractory bricks

-The smelting room of blast furnace consist of throat,stack,body,bosh and hearth

-The powdered raw materials are brought to the top surface with a skip and hoist and then dumped into double bell hopper.

-A hot air blast is forced into the furnace through a number of water cooled nozzles

-In blast furnace reduction of iron ore takes place in different temperature ranges

-

$$3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2$$

$$Fe_3O_4 + CO \longrightarrow 3FeO + CO_2$$

$$FeO + CO \longrightarrow Fe + CO_2$$

$$C + CO_2 \longrightarrow 2CO$$

$$CaCO_3 \longrightarrow CaO + CO_2;\ C + CO_2 \longrightarrow 2CO$$

$$CaO + SiO_2 \longrightarrow CaSiO_3;\ C + CO_2 \longrightarrow 2CO$$

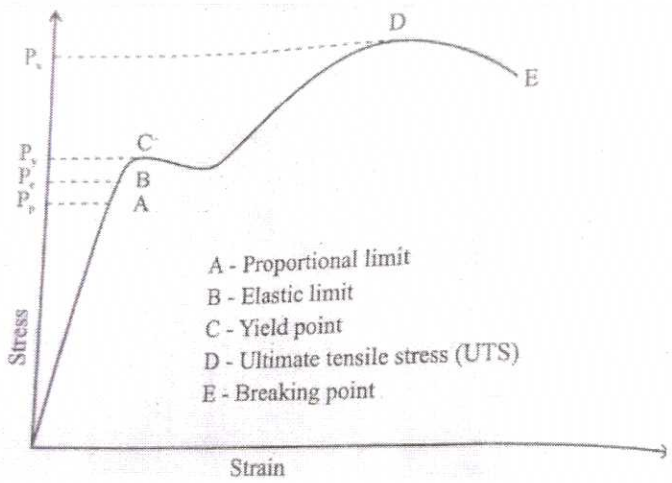
$$C + O_2 \longrightarrow CO_2$$

4

8

IV

a)

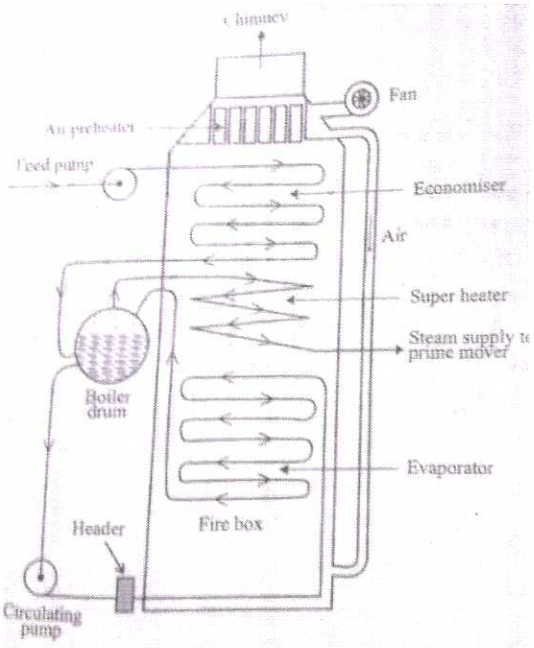


4

	-Point A is the proportional limit. It is the stress at which the stress- strain curve is linear -Point B indicates elastic limit. It is the greatest stress that metal can withstand without experiencing permanent strain -Point C is the yield point. It is the minimum stress at which specimen is deformed without increase in load - Point D represents ultimate tensile strength. It is the maximum stress a material can withstand without fracture -Point E represents breaking point	3		7
b)	Any four of Strength, Hardness, Toughness, Resilience, Brittleness, Creep, Fatigue, Stiffness, Ductility, Malleability, Elasticity, Plasticity	4x2		8

V

a)



4

It is a high pressure boiler having forced circulation system

-Feed water from hotwell is supplied to the storage and separating drum through economiser

Most of the sensible heat is suppliedto the feed water passing through economiser

3

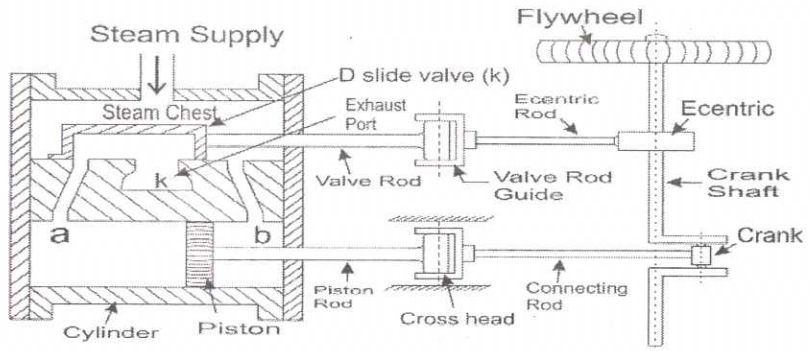
The water from boiler is drawn by circulating pump and is pressurized 2.5 bar above the drum pressure and supplied to headers, which distribute the water to evaporator tubes

Here some water is converted into steam and a mixture of water and steam then passes into the boiler drum

Steam separated in the boiler is further passed through superheater and finally supplied to prime mover

7

b)



4

-The high pressure superheated steam from the boiler is supplied to the steam chest

-This steam is first admitted to the cover end of the cylinder , when the steam admission port 'a' is uncovered by the D slide valve while the steam is exhausted through the steam port 'b' at the crank end and exhaust port

-Now the steam admitted on the cover end exerts pressure on the surface of the piston and pushes it to the crank end of the cylinder

4

-At the end of the stroke fresh steam from the steam chest is agin admitted by the D slide valve to the crank end of the cylinder while the exhaust steam on the cover end is exhauste through the steam port 'a' and exhaust port

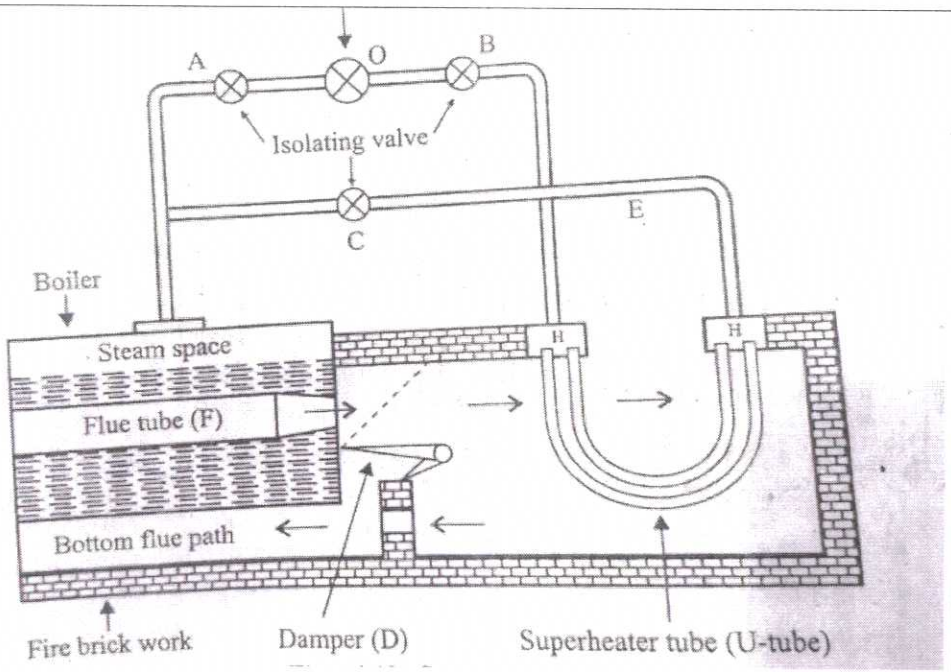
-The D slide valve gets to and fro motion from the eccentric fitted to the crankshaft

-Thus two working strokes are completed and the crankshaft turns by one revolution

8

VI

a)



3

- Superheater is device used to increase the temperature of saturated steam without raising its pressure.
- This is done by passing the steam through a set of superheater tubes and hot gases over them
- It is placed in the path of hot flue gases from the furnace where the temperature of gas is not less than 550 degrees
- It consist of two headers and a set of superheater tubes
- The headers are directly connected to the steam space of the boiler through the pipe E
- -Flow of hot flue gases over the super heater tubes is controlled by using damper D

4

7

10

b)

Fire Tube Boiler	Water Tube Boiler
-Hot gases flow through the tubes which are surrounded with water	-Water circulates through the tubes and hot gases around them
-Free circulation of water	-Forced circulation of water
-Steam pressure is limited to 20-30 bar	-Works even at super critical pressures and temperatures
-Usually used for heating purpose only	-Used for power generation and heating purpose
-Rate of steam production is limited to 9000 kg/hr	-Rate of steam production is as high upto 500000 kg/hr
-Construction is difficult	-Construction is simple
-Chances of explosion is less	-Chances of explosion is more
-They are internally fired boilers	-They are externally fired boilers

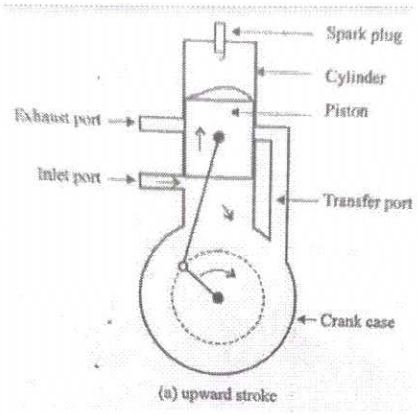
4

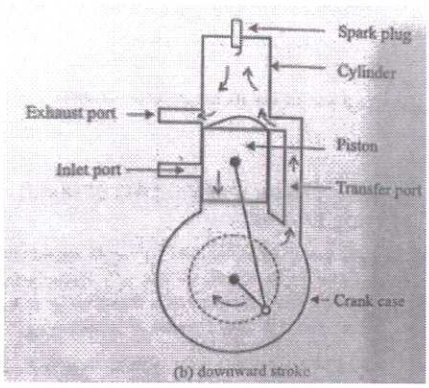
4

8

VII

a)





4

-Power is obtained by one complete revolution of the crank shaft

-As the piston moves downwards it uncovers the inlet port and the air fuel mixture enters the crankcase

-At the same time air-fuel mixture present inside the cylinder is compressed

3

-At the end of compression spark is produced in the cylinder

-The air fuel mixture is ignited and combustion take place

-The burnt gas starts expanding and pushes the piston downwards

-Thus the power stroke take place

-During expansion piston covers the inlet port and uncovers the exhaust port.

-Then the transfer port is uncovered and the compressed air fuel mixture from the crank case flows into the cylinder

7

b)

Explain any of the following four parts

1)cylinder 2)piston 3)piston ring 4) Connecting rod

5)Crank shaft 6)Flywheel 7) Valves 8)Cam mechanism etc

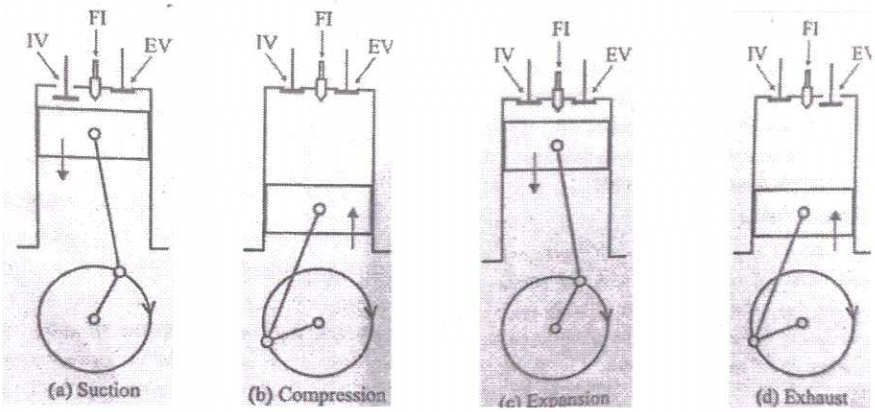
4x2

8

Write Any four

VIII

a)



4

The four stroke cycle diesel engine operates on diesel cycle or constant pressure cycle

7

Suction Stroke: During suction stroke, the piston is moved from the top dead centre to the bottom dead centre by the crankshaft.The inlet valve remains open and the exhaust valve is closed during this stroke

3

Compression Stroke: The air drawn at the atmospheric pressure during suction stroke is compressed to high pressure and temperature as piston moves from the bottom dead centre to top dead centre. Just before the end of this stroke, a metered quantity of fuel is injected into the hot compressed air in the form of fine sprays by means of fuel injector

Working Stroke: The expansion of gases due to the heat of combustion exerts a pressure on the piston. Under this impulse, the piston moves from top dead centre to moves from top dead centre to the bottom dead centre and thus work is obtained in this stroke. Both the inlet and exhaust valves remain closed during this stroke

Exhaust Stroke: During this stroke, the inlet valve remains closed and the exhaust valve exhaust valve opens. The greater part of the burnt gases escapes because of their own expansion.

b)

SI engine	CI engine
-Working cycle is Otto cycle -Petrol is used -High self-ignition temperature. -Fuel -air mixture is supplied in the suction stroke. -Carburettor is used to provide the fuel-air mixture. -Use of spark plug for ignition system -Compression ratio is 6 to 10.5 -Maximum efficiency lower due to lower compression ratio	-Working cycle is diesel cycle used. -Diesel is used. -Low self-ignition temperature -Fuel is injected directly into the combustion chamber at high pressure at the end of compression stroke -Injector and high pressure pump used to supply of fuel. -Compression ratio is 14 to 22 Higher maximum efficiency due to higher compression ratio Heavier due to higher pressures

4

4

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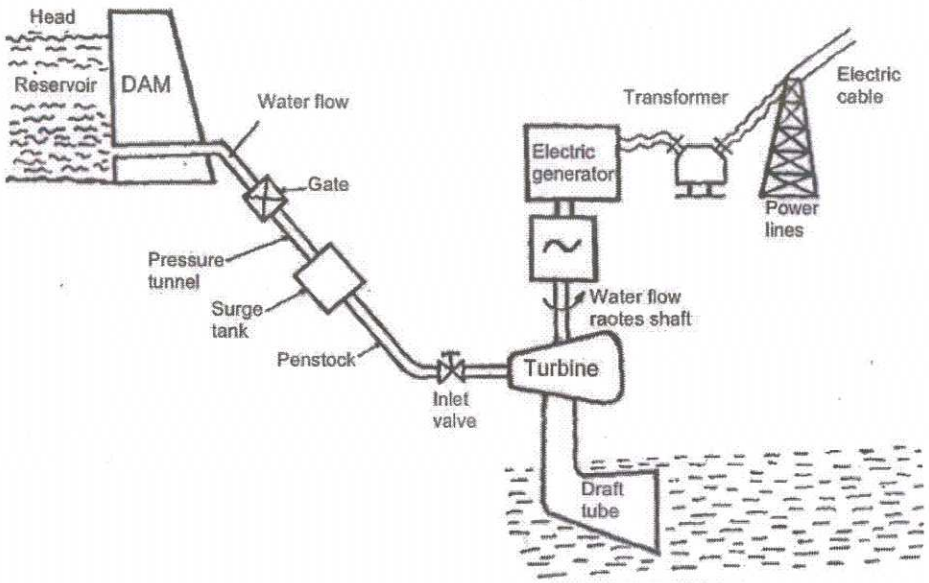
IX

a)



4

Hydropower plants capture the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy.

-Water harvested from the catchment area is stored in the reservoir which is then used to generate the electricity.

-Dam is made in the path of the river to make the reservoir to hold the rain water.

3

- surge tank is build in between dam and the valve house. It is used to take care of the system load fluctuations.

- water pipeline carrying water from dam to turbineis called penstock.

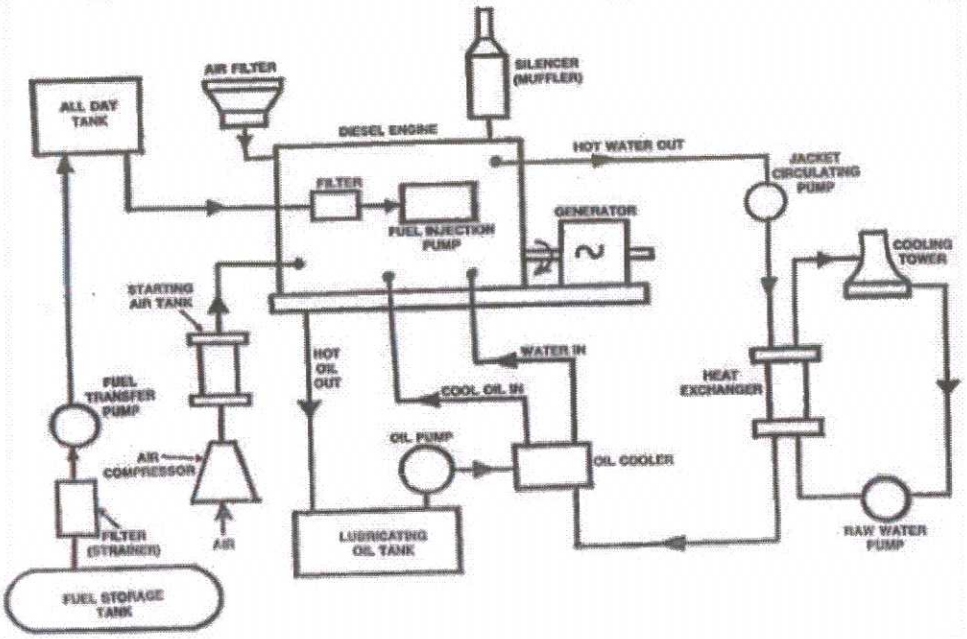
-Prime mover or turbine is the main part of the power station. It is coupled with the generator. Turbine is rotated by the flow of water. As it is coupled with the generator, generator also rotates which produces electricity.

Powerhouse: it consists of turbine, alternator and electrical equipment.

Tail races: outlet water of the turbine is discharged to the river trough tail races.

7

b)



4

8

The working principle of the diesel power station is to compress the air in a cylinder to raise the temperature, then we burn the diesel inside the engine and the combustion produces the working fluid at high_temperature and high_pressure to convert the heat energy into mechanical energy and as the diesel engine acts as a prime mover it rotates the rotor of the electrical generator and converts this mechanical energy into electrical energy.

4

The main components are

- **Diesel Engine**: it's the main part of the plant which used to <u>produce power</u>, it may be of the two-stroke or four strokes.
- **Fuel supply system**: it consists of a storage tank where we store the oil supplied to the plant, all day fuel tank where the oil pumped for usage, strainer which used to remove suspended impurities of the oil, and fuel injection (transfer) pump which used to inject the clean oil into the engine.
- **Strainer**: it's used to remove solid impurities from the oil transferred from the main tank to small dry tank through this strainer.

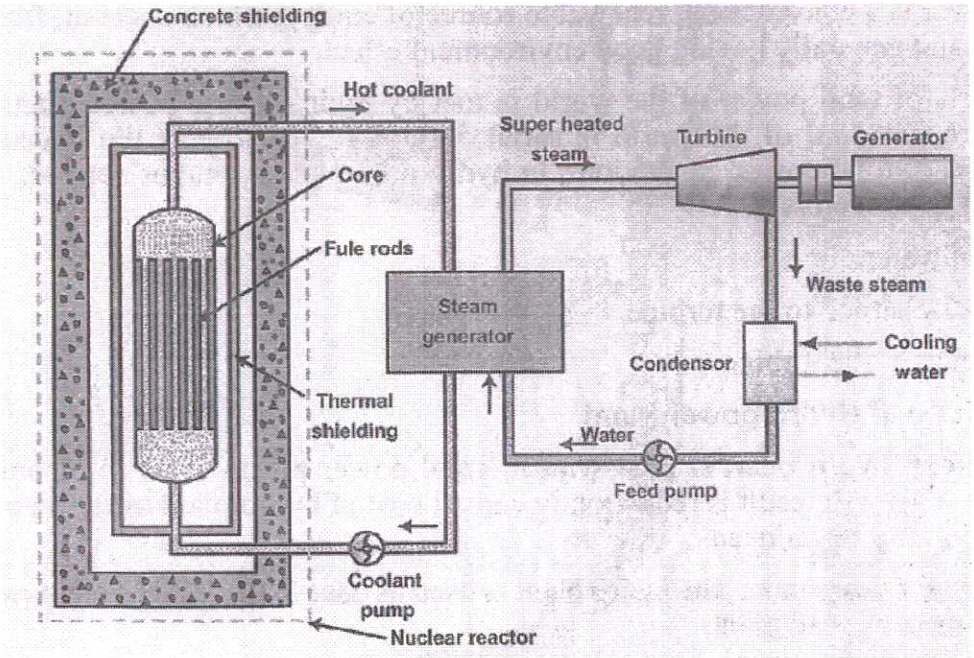
- **Air intake system**: it's used to remove the dust particles from the atmospheric air to supply fresh air to the engine for <u>combustion</u>, it may be dry (or oil) bath filter or oil immersed filter, and it consists of pipes to supply the fresh air and filters to remove dust particles from the air.
- **Exhaust system**: it's used to remove the exhaust gas from the engine to the atmosphere, and we also add a silencer to this system to reduce the noise level of the system

Cooling system : It very important in the diesel power station to have a cooling system to maintain the overall temperature of the engine at an agreeable level, and this cooling system requires a water source, a water pump which circulates water through a cylinder, and cooling towers which used to cool the hot water.

Lubricating system: it's used to minimize the wear of the rubbing surface of the engine as we store oil in a main lubricating oil tank then draw this oil from an oil pump to pass through the oil filter to remove impurities.

X

a)



4

-Reactor: Nuclear fission takes place in the reactor only.Nuclear fission produces large quantity of heat.

-Control Rods: They are used to control the chain reaction.
They are absorbers of neutron.

Moderator: Moderators are used to slow down the fast neutrons

3

7

-The heat generated in the reactor due to the fission of the fuel is taken up by the coolant.

-The hot coolant then leaves the reactor and flows through the steam generator.

-In the steam generator the hot coolant transfers its heat to the feed water which gets converted into steam.

-The steam produced is passed through the turbine, which is coupled with generator.

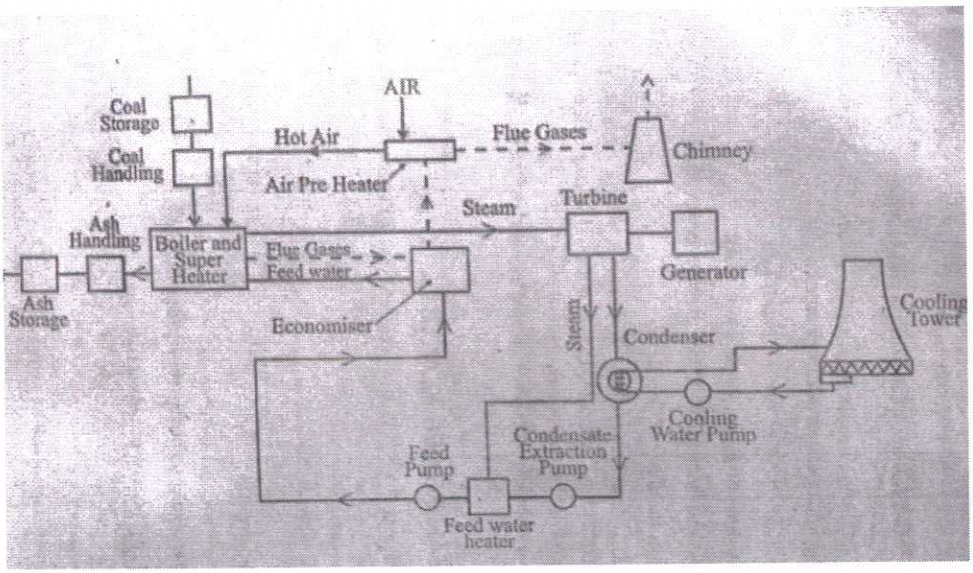
-Hence the power is produced during the running of turbine.

-The exhaust steam from the turbine is condensed in the condenser.

-The condensate then flows to the steam generator through the feed pump.

-The cycle is thus repeated

b)



4

-Coal is pulverized into powdered form

-This coal is fed into the furnace along with pre-heated air and is ignited

-The burning take place and the heat generated is used for conversion of water into steam

-The high pressure and high temperature steam is then fed into steam turbine

4

-In steam turbine steam is expanded and the thermal energy of steam is converted into mechanical energy

After doing useful work in steam turbine the exhaust steam flows into condenser where it is condensed to water

8