Sample Question Paper
Scheme – I

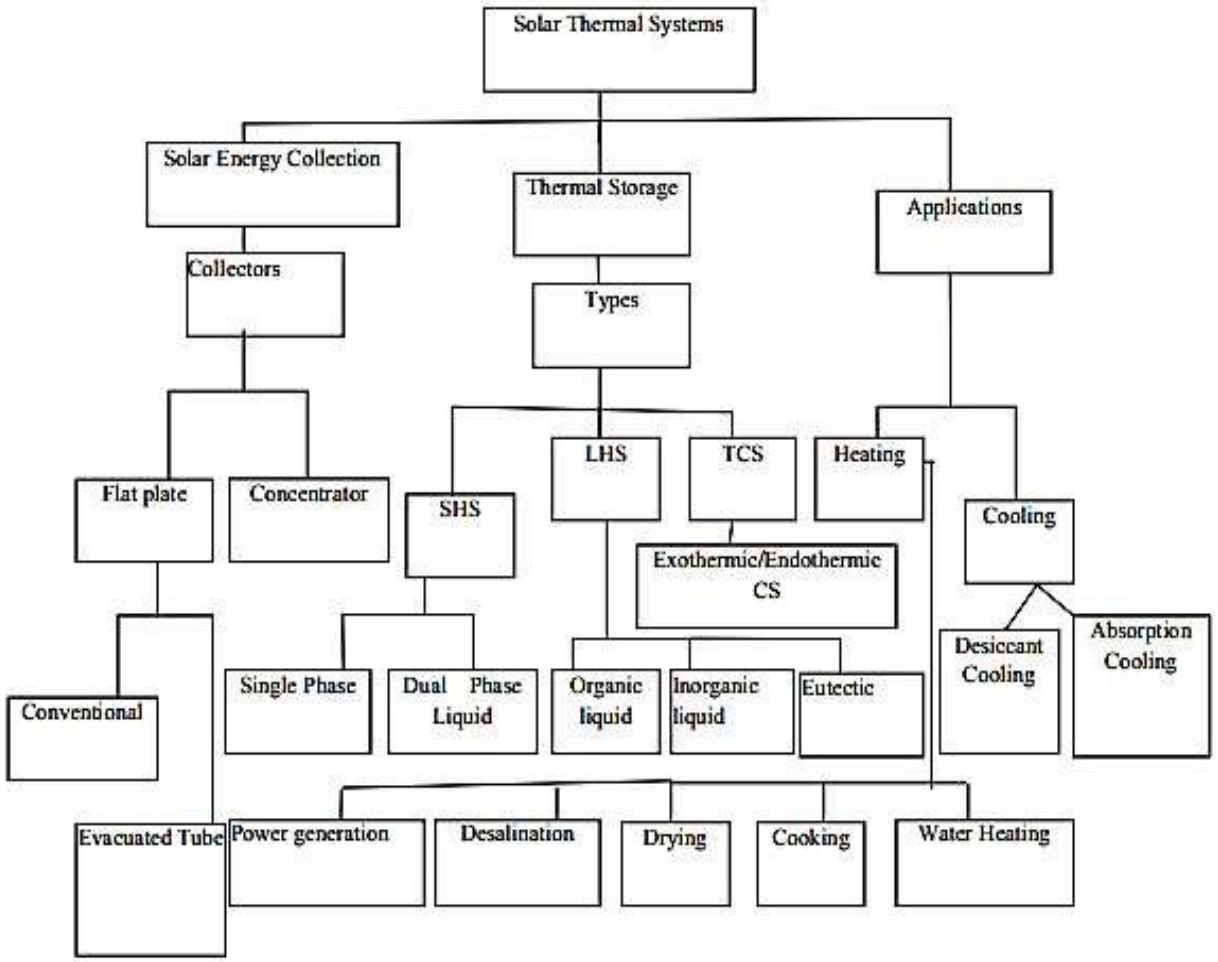
22661

Programme Name : Mechanical Engineering
Programme code : ME
Semester VI
Course Title : Renewable Energy Technologies
Marks : 70 **Time : 3 Hrs.**

Q.1) Attempt any FIVE of the following. **(10 Marks)**

a) **Classify Solar Thermal System**

ANS)



A) Passive system:

Passive system thermal energy system , the collection , storage & distribution of solar thermal is done natural way.

B) Active system:

In an active , solar thermal energy system is collected by solar collect or eighter by water , air or any other fluids.

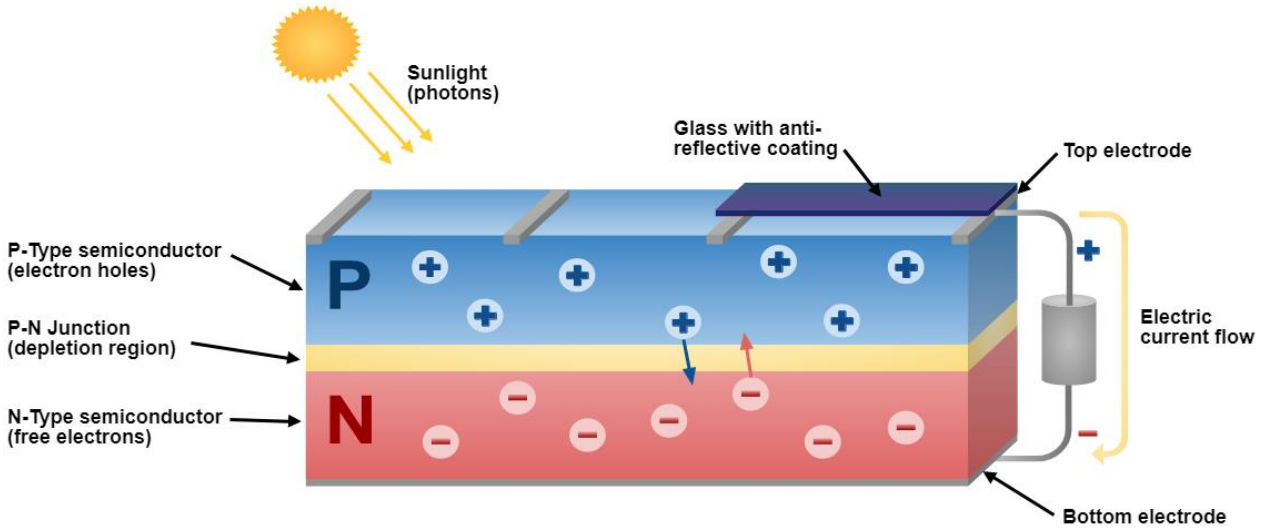
b) List applications of Bio Fuel (any four)

ANS) The applications of Bio-Fuel

1) Domestic Heating
2) Domestic cooking
3) Commercial Process Heating
4) Power Generation
5) Transportation
6) Energy Generation
7) Provide Heat

c) State the function of PV Cell

ANS) A solar cell (also known as a photovoltaic cell or PV cell) is defined as an electrical device that converts Solar energy into electrical energy through the photovoltaic effect. A solar cell is basically a p-n junction diode.



d) Write specification of HAWT

ANS)

Sr.No	Name of Specification	Details
1	Rated Power	2.7MW
2	Rated Wind Speed	9.5m/s
3	Cut-in Wind Speed	3m/s
4	Cut-out Wind Speed	30m/s
5	Rotor Diameter	129m
6	Generator	Frequency – 50Hz/60Hz
		Type- Slip Ring Asynchronous generator
7	Tower	Hub Height: Up to 140m
		Type: Steel Tubular ,Hybrid

e) Name any four components of Micro Hydro Power System

ANS) **1. Forebay**

A forebay is a basin area of hydropower plant where water is temporarily stored before going into intake chamber. The storage of water in forebay is decided based on required water demand in that area. This is also used when the load requirement in intake is less.

2. Intake Structure

Intake structure is a structure which collects the water from the forebay and directs it into the penstocks.

3. Penstock

Penstocks are like large pipes laid with some slope which carries water from intake structure or reservoir to the turbines. They run with some pressure so, sudden closing or opening of penstock gates can cause water hammer effect to the penstocks.

4. Surge Chamber

A surge chamber or surge tank is a cylindrical tank which is open at the top to control the pressure in penstock. It is connected to the penstock and as close as possible to the power house.

5. Hydraulic Turbines

Hydraulic turbine, a device which can convert the hydraulic energy into the mechanical energy which again converted into the electrical energy by coupling the shaft of turbine to the generator.

6. Power House

Power house is a building provided to protect the hydraulic and electrical equipment

7. Draft Tube

If reaction turbines are used, then draft tube is a necessary component which connects turbine outlet to the tailrace. The draft tube contains gradually increasing diameter so that the water discharged into the tailrace with safe velocity. At the end of draft tube, outlet gates are provided which can be closed during repair works.

8. Tailrace

Tailrace is the flow of water from turbines to the stream. It is good if the power house is located nearer to the stream. But, if it is located far away from the stream then it is necessary to build a channel for carrying water into the stream.

f) Define term ‘ Battery rating’

ANS) A battery’s charge and discharge rates are controlled by battery Rates. The battery Rating is the measurement of current in which a battery is charged and discharged at.

g) Name any four Hybrid systems

ANS)

1) Wind-Solar Hybrid systems
2) Wind-Biogas Hybrid systems
3)Solar-Biogas Hybrid systems
4)Biomass-Solar Hybrid systems

Q.2) Attempt any THREE of the following. (12 Marks)

a) Differentiate between flat plate collectors and Parabolic Collectors

ANS)

Sr.no	flat plate collectors	Parabolic Collectors
1	The absorber area is large	The absorber area is small
2	Temperature Not more than 100^0c	High Temperature up to 3000^0c
3	Its use both Beam and Diffuse radiation	Its use mainly beam radiation
4	Simple in construction	Complex in construction
5	Easy Maintenance	Difficult to Maintenance
6	NO, Need of tracking System	Need of tracking System
7	Maintenance cost is less	Maintenance cost is more
8	Suitable For All the Places as it work in clear and cloudy days	Suitable where there are more clear days in year
9	Low temperature application	temperature application

b) Write different methods of Battery selection

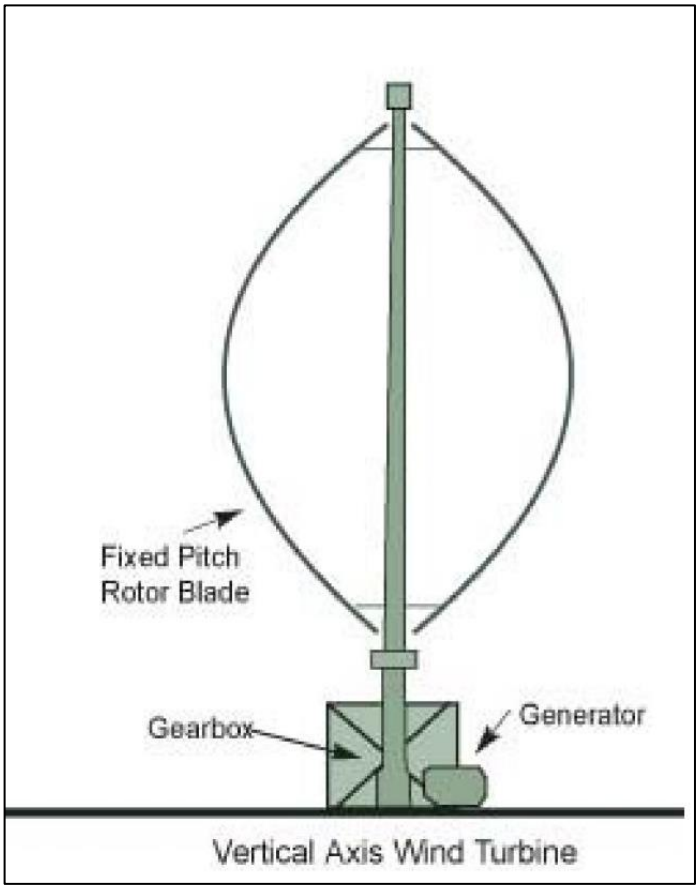
ANS)

The different methods of Battery Selection

Sr.no	Methods	Meaning
1	Low cost	Initial and operating cost should be less
2	Long life	Length of Time over which operation is required, should be High
3	Shelf life	Allowable Storage time
4	Low self-discharge	Less Discharge Profit
5	Maintenances	Difficult to maintenances batters
6	Battery Type	Primary, Secondary, fuel cell system
7	Physical Requirement	Size, Shape, weight limitations
8	Environmental Conditions	Pressure, Humidity, Shock, Vibration, spin

c) Explain the importance of Small Vertical Axis wind Turbines

ANS)



The Important of small vertical Axis wind Turbines

1)Its does not need any yaw control mechanism since vanes of wind mill can accept the wind from any direction

2)Its does not need to support nacelle on top of tower since the gear box , brakes , generators are located on ground

3)Overall cost of wind mill is less

4)The cost of maintenances is also less

5)Design of whole structure is comparatively less

d) Write maintenance procedure of Micro hydro Power system

ANS)

Micro Hydro Power Maintenance:

(1)Firstly , check whether all components are completed and the intake of pen stock is blocked.

(2)Then check whether the runner of turbine can be easily rotated ,and rotated in by hand to ensure the voltage meter has readings(put the output switch in OFF position).

(3)For the first starting ,the output switch should be put in the voltage-stabilized control position(A),then open the gate to let water out from small to large, observe the readings meter till 220v or so continue enhancing water volume, the voltage device is reliable if the reading keep still, At this time the load can be connected ,then adjust the water volume to hold the output of 220v or so .Once the stabilizing device break down, put the switch in B ,then the voltage of unit will be under manual-controlled, you may follow the next procedure to control by valve.

(4)During the operation, the load should be kept stable as possible as can be. Don't shut off the load suddenly, or else the high voltage will burn out the rest load, if you must disconnect the load, you may decrease water to small volume at first, then disconnect the most part of load when the voltage has dropped to below 220v(you must do as this even you run the unit under the using of voltage-stabilizing device).

(5)It need only close the valve to switch off the unit when the load has been stable after first operation, The power switch may hold on so that you may adjust voltage up to 200-220v directly for next running.

(6)To check and clean the mud and foreign material blocking in the intake house and trash rack.

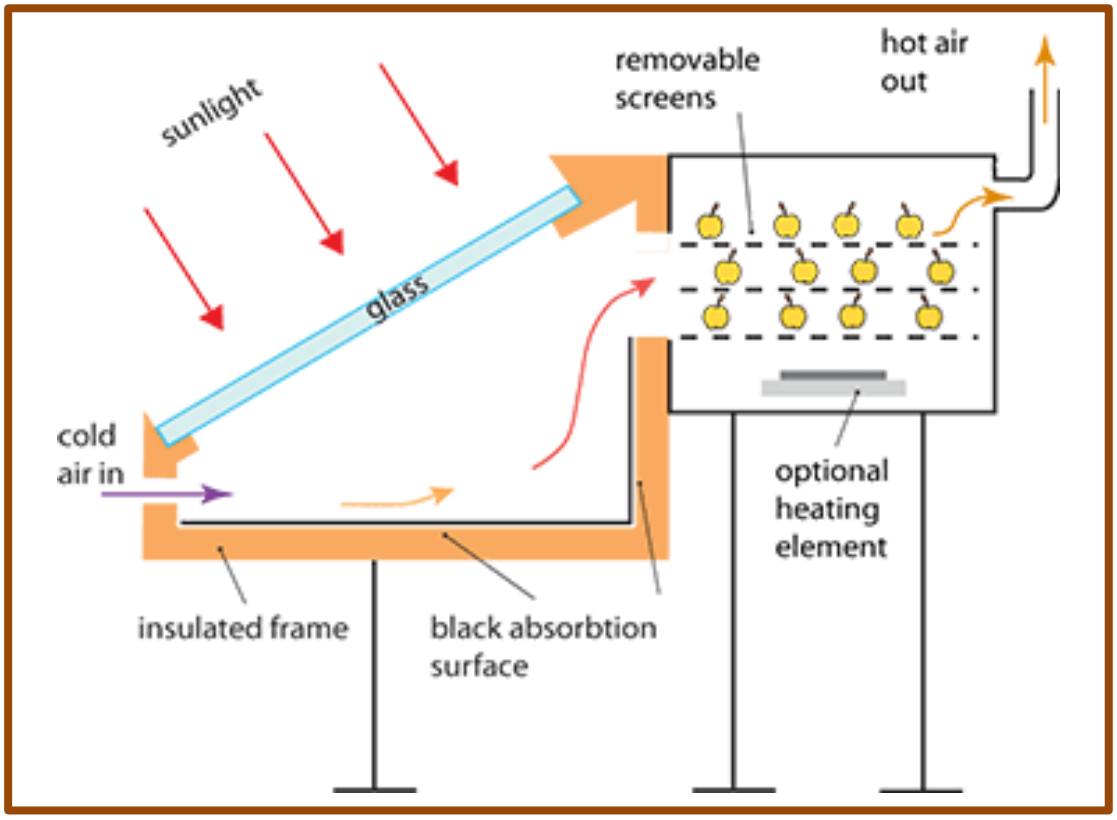
(7)the frame of unit should be injected water-proof grease by using grease cup in every three months ,each time rotating for three times. The upper bearing also should be added water-proof grease for every six months.

(8)The generator must be conducted the dry treatment before next start if it became wet.

Q.3) Attempt any THREE of the following. (12 Marks)

a) Explain working of Solar dryer with neat sketch

ANS)



1) These are passive type solar dryers which do not use any external power for running a fan
2) This are suitable for drawing the foods products on small scats
3) It has enclosed cabinet having transparent glass cover at the top & insulation provide at bottom
4) The inner surfaces of cabinet are coal black
5) Ventilation holes are provided at the bottom for fresh air to enter

b) Explain the term ‘ Net Metering’

ANS)

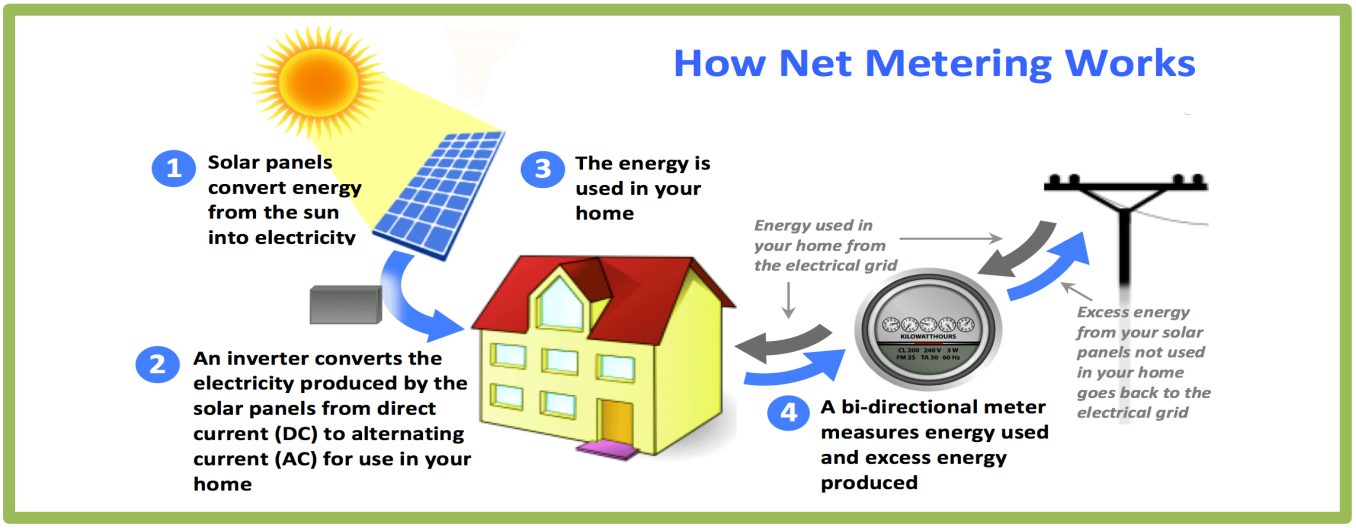
Net Metering can be defined as billing machine which gives credits to owners of solar energy system for electricity, they add to the utility grid network

For example

Suppose a residential customer has a solar P.V system on roof his/her house and a bi-directional meter is fitted to the house instead of convention un-directional meter.

Now there are two possibilities

1) Solar PV system may generate more electricity than the electricity consumed by electrical appliances of house during daylight hour. Then the excess amount of electricity generated is sent to utility grid network. In such case the meter will run backwards
2) Solar PV system is unable to generate electricity during night hours. Then the residential customer will use the electricity provide by utility grid to fulfil demand of electricity. In such case the meter will run forward.



Since the bi-directional meter works in two direction

i) One way to measure of electricity purchased from utility grid
ii) Second way to measure of electricity returned to utility grid

The customer has to pay the bill for the differences between purchased and electricity returned. This differences is called as net energy use and the billing mechanism is called as net metering.

c) Write maintenance procedure of ‘ Bio gas plant’

ANS)

- Maintenance can be defined as the combination of all prescribed technical and associated administrative actions performed to retain a system, so that, it will be restored to a state, in which, it can perform its required function.
- In simple words, maintenances action is, nothing but, the prescribed operative process to correct an equipment failure, when the equipment fails to operate
- Generally, maintenances are divided into 3 types
- (1) corrective maintenances

  corrective maintenances are carried out after a failure has occurred

  This means that, the working of wind mill has to be stopped , until the failed component is either repaired or replaced by new one.
- (2) Preventive maintenances

  Preventive maintenances activity is carried out at predetermined schedule to reduces the probability of failure .

  Preventive maintenances activities are planned and periodical.

  Preventive maintenances are of two types

  (i) Indirect Preventive maintenances.

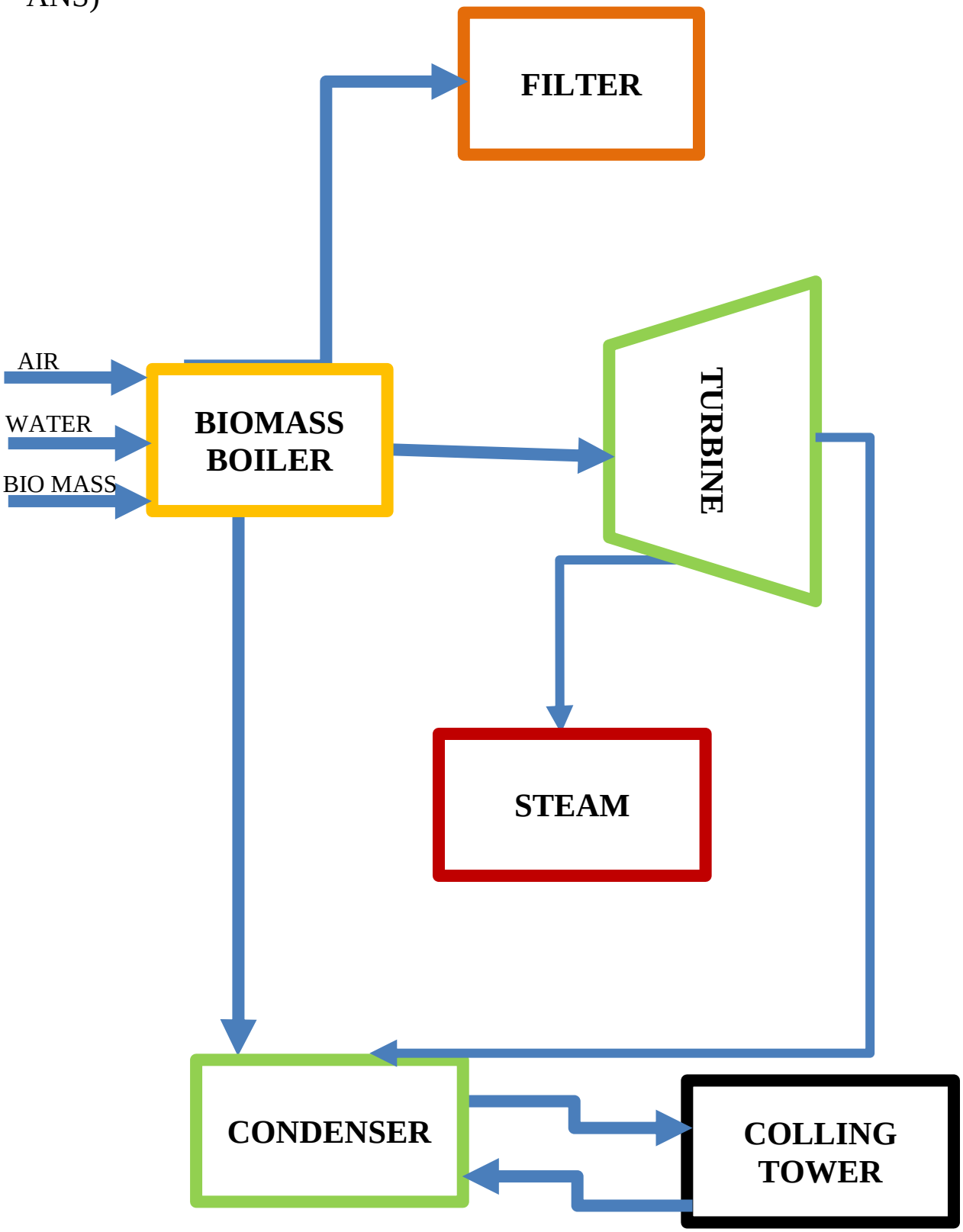
(ii) Direct Preventive maintenances.

- (3) Improvement maintenances

Improvement maintenances is the program of initiatives taken to improve the operational reliability from a maintenance aspect.

d) Draw layout of 'Bio mass power plant.

ANS)



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Q.4) Attempt any Three of the following. (12 Marks)

a) Write installation procedure for Micro hydro power systems in brief

ANS)

Step(1): Planning a micro hydro power scheme and selecting site: The definitive project or scheme comes out as a result of a complex process involving iterations, where consideration is given to an environmental impact and different technological options.

1) Topography and geomorphology of the site.
2) Evaluation of the water recources and its generating potential
3) Site selection and basic layout
4) Hydraulic turbines and generators and their control
5) Environmental impact
6) Economic evaluation of the project and financing potential

Step(2): Plant layout, Transport of the water and Measurement

- **Layout of the plant**: It is crucial to prepare the map of land area, on which, he facility is to be constructed. On this map, the layout of the plant is outlined. This exercise will enable to check best possible ways to direct the water, identify the components of the plant in the landscape etc.
- **Solution for water transport:** water is transported from the diversion weir to power house. Depending upon the specific physical features of area, all the possible options for transporting the water from diversion weir up to the power houses are evaluated.

Sr. No.	Value of head available	Solution for water transport
1	High head	Short direct penstock
2	Medium to high head	Short penstock with long channel long penstock with short channel
3	Low head	Long channel

- **Measurement:** following are important parameters should be measured on the site
  (i) Flow and velocity measurement
  (ii) Head measurement
  (iii) Performing power calculations.

Step(3): Civil work commissioning

1) Diversion weir:

Types of weir	Features
Sharp-crested weir	Simple and cost-effective design.
Broad-crested weir	Simple and cost-effective design

2) Intake construction with trash rack installation

- Channels
- Spillways
- Forebay

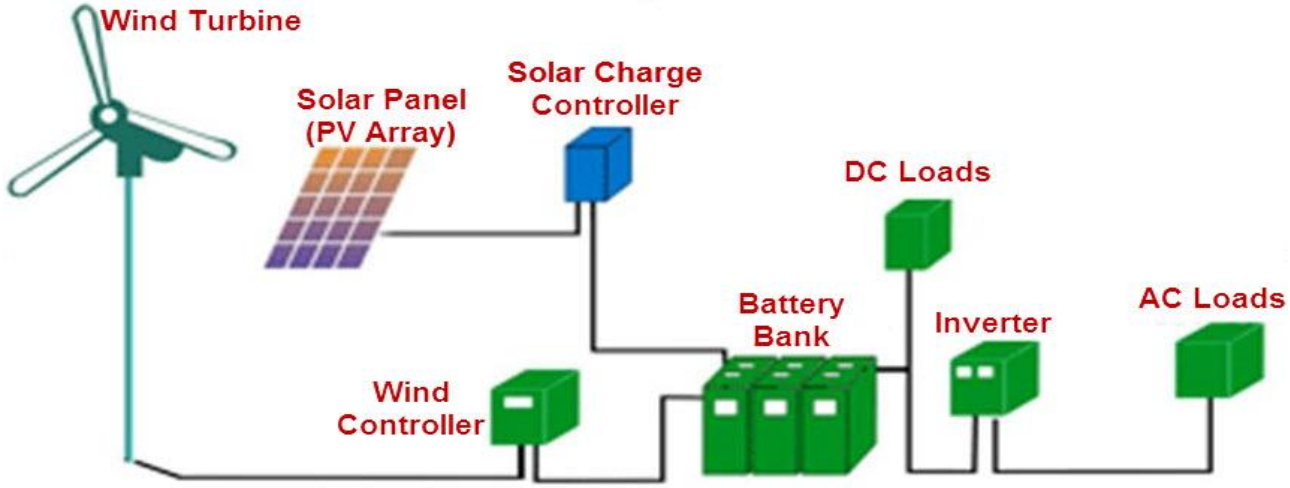
3) Penstock installation
4) Gates have to installed
5) Design of power house

Step(4): Installation procedure for turbine and power house:

1) Work on selected site
2) Construction of intake channel & turbine house
3) Finishing the intake channel
4) Finishing the turbine house
5) Installing the draft tube in spaces
6) Installing the turbine
7) Connect and fit all Parts

b) Explain the working of wind- solar Hybrid system

ANS)



A system using combination of wind power, solar power called as solar wind hybrid system

During favorable wind, period the wind turbine generates AC power.

It may be used directly and connected to AC loads. The excess AC power is converted into DC and store in batteries bank

During the day time and favorable sun shine, the solar system converts the solar radiations received it directly into DC power. It's stored in the batteries bank

The DC power is converted into AC by an inverter. This power is supplied to various consumers, street lighting, pumping etc. through the consumer devise

Battery act storage system. It stores the Excess power when demand of energy by consumer is less than the power produced by the solar-wind system

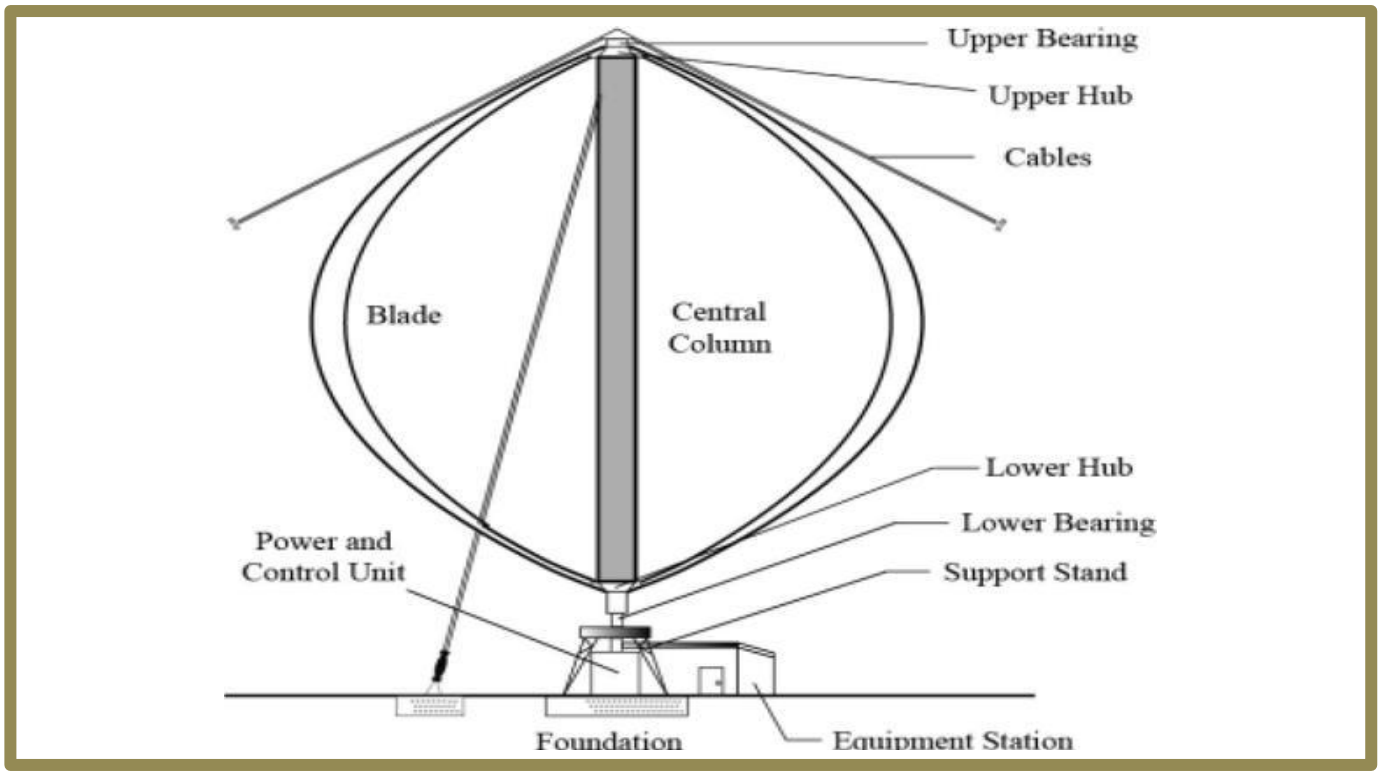
When the power produced by the system is less, the additional energy needed by the consumer is supplied from the battery.

c) List different performance parameters for testing performance of Wind solar PV Hybridsystem

ANS)

d) Explain with neat sketch working of VAWT

ANS)



- Vertical Axis wind Turbine (VAWT) is also know as vertical axis wind mill.
- Large vertical axis wind mill or VAWT consist of darrius type rotor, blades, support structure enclosing gear box, generator brakes, electrical switchgears, and control.
- Tower is hollow vertical rotor shaft, which rotates freely about the vertical axis from the top-bottom bearing. It is installed above a support structure
- The upper part of the tower is support by guy ropes.
- The height of tower of large turbine is around 100 meters
- Vertical axis wind mill or VAWT has two or three thin blades. These blades should be in curved in such way that, the bending stress induced due to centrifugal forces are minimized.
- The blades have an air foil cross-section with constant chord length.
- Here, pitch of blades cannot be changed
- The diameter of rotor is slightly less than tower height
- The support structure is provide at a ground to support the weight of the rotor.

- Air strikes on blades & rotates them with high velocity & rotates shaft
- This rotational motion is given to generator

- The generator converte the shaft rotations into electricity

e) List the applications of Micro Hydro power systems

ANS)

Application of micro-Hydro Power system

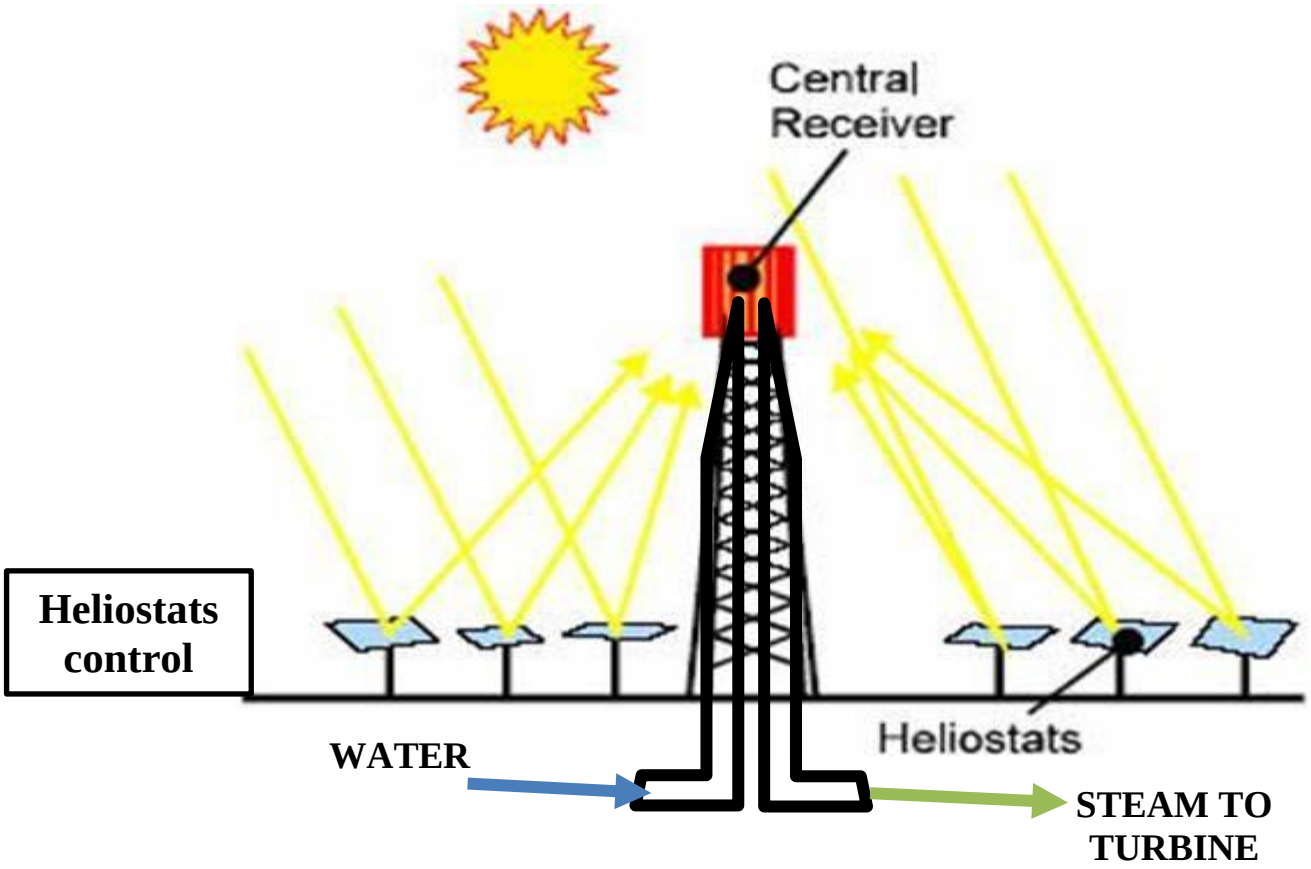
1) Domestic lighting
2) Cooking
3) Operation of Radio & Tv
4) Fertilizer production
5) Production of electricity
6) Argo processing
7) Cooling
8) Heating
9) Drying
10) Fabrication

Micro-hybrid power system are small hydropower plants that generators capacity is less than 10KW

Q.5) Attempt any TWO of the following. **(12 Marks)**

a) Explain with neat sketch the construction of 'Solar Tower'

ANS)



Working

1) To collect large amount of heat energy at one point the central receiver concept is followed.

2) Solar towers have large number of heliostats which are spread over a large area.

3) Solar radiation is reflected from heliostats to centrally located tower in the receiver.

4) Each heliostats means an array of large number of mirrors

5) The word heliostats mean an array of large number of mirrors

Construction

1) Heliostats are the sun tracking mirrors fixed on the ground.

2) Receiver are fixed on the top of tower which transferred heat energy to fluid.
Receiver has variety of shapes like cylindrical cavity etc. .

3) Heat transport system consist of pipes pumps and valves.
Heat transfer take places in closed loop. The system and molten salt are used to heat transfer fluids

4) Thermal storage is used to store the energy

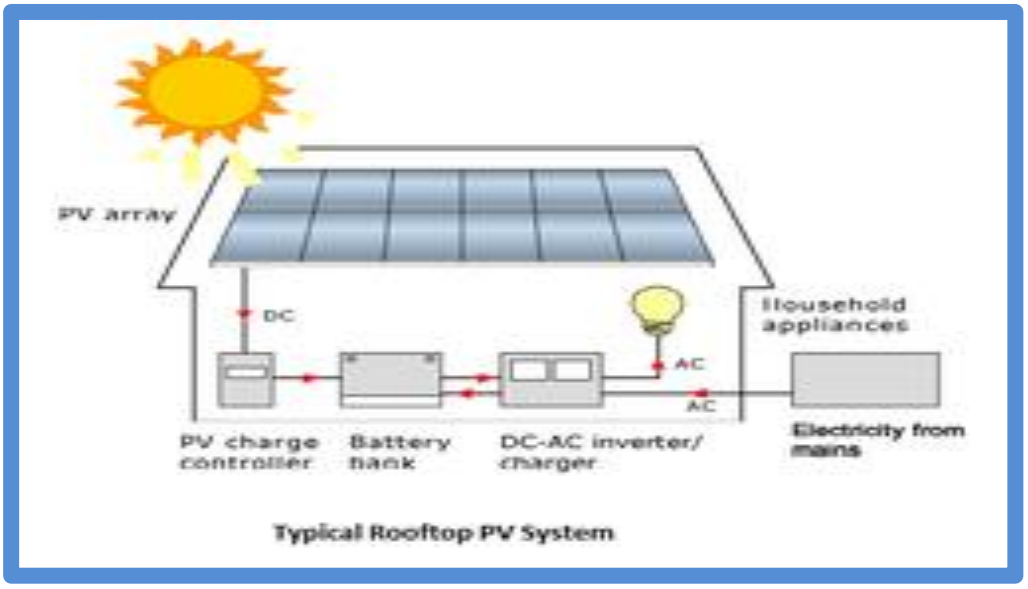
5) Power conversion system: The aim of the system is to convert thermal energy into electricity energy.

b) Write in detail the maintenance procedure of large Horizontal axis wind turbine

ANS)

c) Explain the installation procedure for solar roof Top system

ANS)



Installation of solar roof top system

1) Mounting structures made of aluminum are well grounded on roof top to take load of PV panels & also wind loads

2) Install PV panels in south direction at lift angle for maximum absorption of radiation

3) Solar modules are fixed on mounting structures with help of nut & bolts

4) Series connection is used to match with the voltage of battery bank

5) Connect the solar wire panel with inverter and connect the positive wire to positive & negative to negative

6) Join inverter with battery bank and connecting battery with home connection

7) The inverter and battery room should be separate room with proper ventilation

Q.6) Attempt any TWO of the following. (12 Marks)

a) **Write the standard installation procedure for 'Industrial Process heating Application.**

ANS)

1) Before complete installation do not switch on electric supply
2) Water tank & conventional heater is enclosed in 5 cm thick polymethine
3) For protection against excessive temp & pressure. It should be installed with temp & pressure relief valve
4) Heater should be placed on cleaned & hard ground
5) A control unit has pump switch & 2 preset temp sensor one each installed at exit pipe of collector & another in tank
6) All valve & fittings should be tightened to avoid leakage
7) Proper heat exchange should be installed according to application
8) Check all the equipment & fitting properly

b) Prepare project feasibility report for Wind –Biogas plant

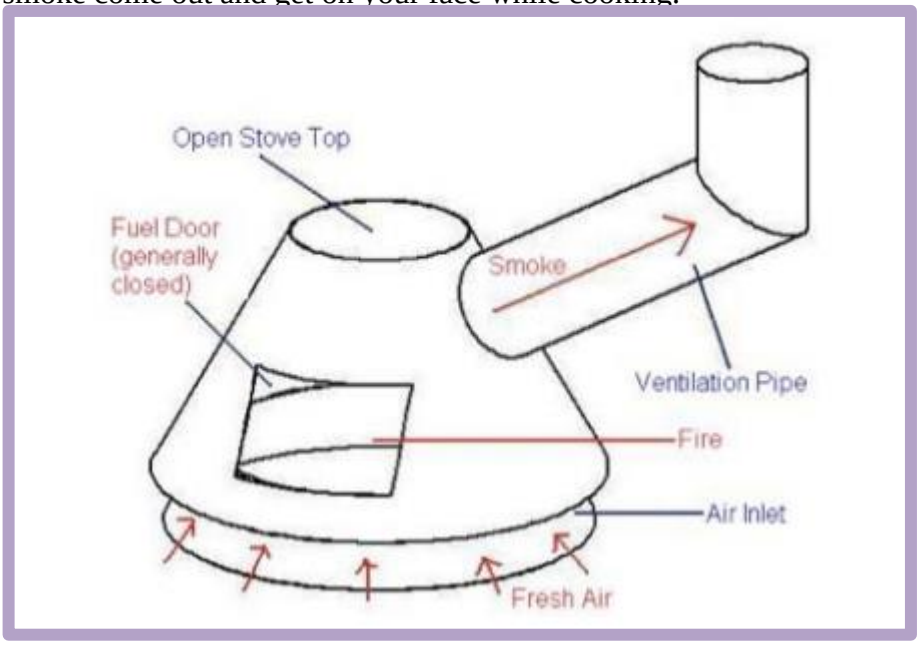
ANS)

c) Explain with neat sketch the construction of ' smokeless Chulhas.

ANS)

- Smokeless chulhas can be construed in different models and size. The standard family unit is with oven
- A cast iron reducer plate is also supplied to accommodate smaller vessels
- In this oven firing is made only in two ovens at a time. The third ovens get heat from the flame these two ovens its normally used working water food etc.
- Firing can be done in one oven also depending on the use
- The passage to the unsure oven should be closed by using shutter supplied with the unit
- This will stop flow smoke gases in the house
- Smokeless chulhas are commonly used in house, canteens hotels etc. for cooking purpose
- The main advantage of installing smokeless chulha is that, it not emits smoke in kitchen.
- The traditional method of cooking in rural areas is on Chulah The fuel is burnt under cooking pot. The thermal efficiency of this chulah is about 5 to 15 percent. It requires large quantity of fuel. The smoke makes the cooking ports dirty and increases the work load of women.
- The smokes also create the problem of eye and chest diseases in women take more time to cook. Smoke entering into the kitchen room leads to Indoor Air Pollution.

- Smokeless chulha does not mean that without smoke. It generates smoke but is vented out of the room using pipe. The idea of smokeless chulha is not let all of the smoke come out and get on your face while cooking.



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