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Internal Assessment Test 2 – July 2024

Sub:	Renewable Energy Resources					Sub Code:	21EE652	Branch:	All branches
Date:	10.07.2024	Duration:	90 min's	Max Marks:	50	Sem / Sec:	VI		OBE

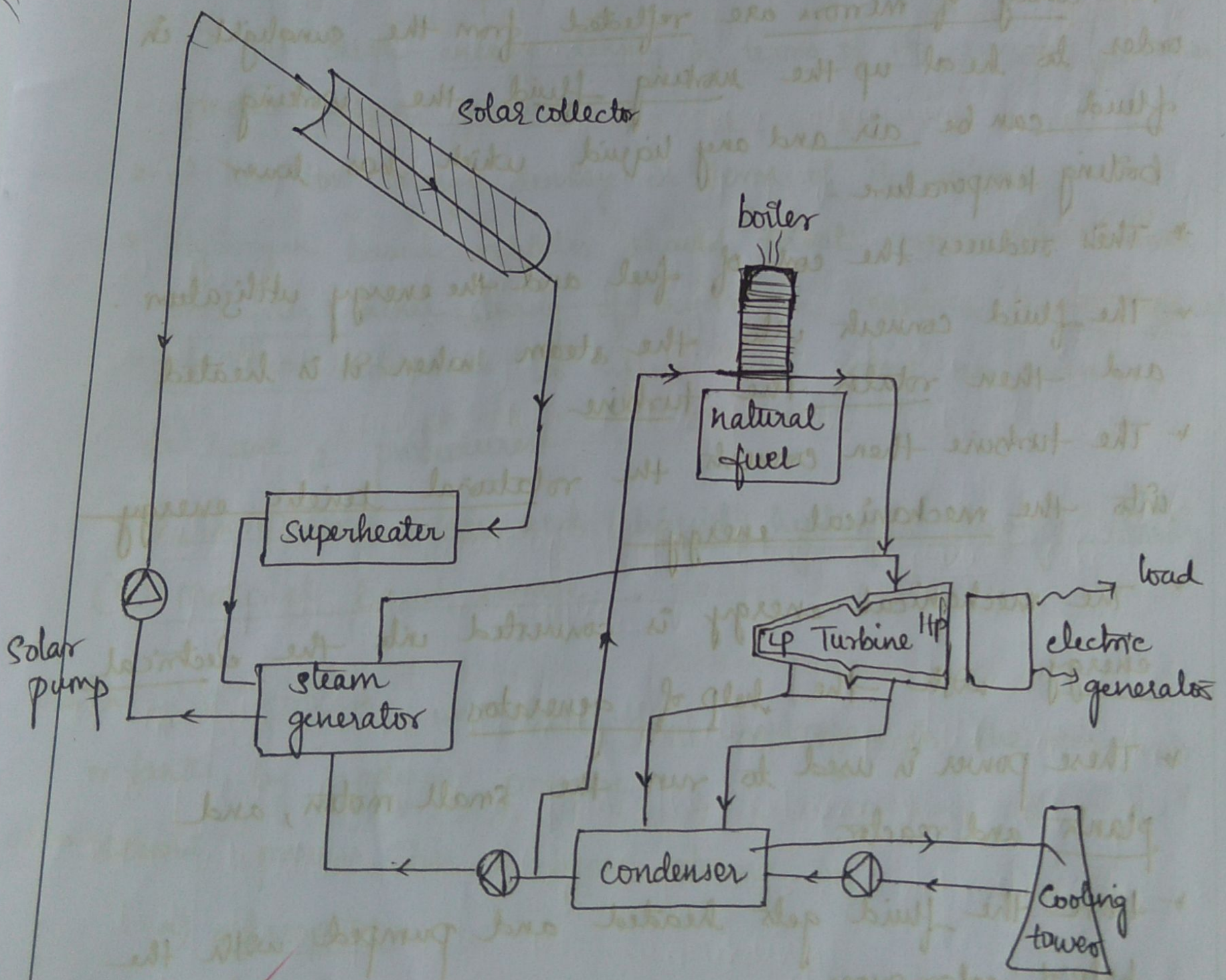
Answer any five questions

		MARKS	CO	RBT
1	With a neat schematic, explain working of Stirling or Brayton heat engine system.	[10]	CO2	L2
2	Explain the principle of solar photovoltaic power generation and list the vital components of solar PV systems, with brief description.	[10]	CO2	L2
3	Discuss the applications, advantages and disadvantages of hydrogen energy.	[10]	CO2	L2
4	Discuss wind characteristics and guidelines for wind turbine site selection.	[10]	CO2	L2
5	With help of a neat diagram, explain working of a binary cycle based geothermal power plant	[10]	CO3	L2
6	Explain the parts of wind turbine with a neat diagram	[10]	CO3	L2

Signature of CI Signature of CCI Signature of HoD

① Stirling / Brayton heat Engine system :-

* schematic representation :-



Brayton Heat Engine

* working of stirling or Brayton heat engines :-

* It is similar to the ancient heat engine, which is has been used from 100 of years
* the array of mirrors are reflected from the sunlight in order to heat up the working fluid, the working fluid can be air and any liquid which has lower boiling temperature.
* This reduces the cost of fuel and the energy utilization.
* The fluid converts into the steam when it is heated and then rotates the turbine
* The turbine then converts the rotational kinetic energy into the mechanical energy
* the mechanical energy is converted into the electrical energy with the help of generators.
* These power is used to run the small motor, and plants and reactor.
* Here the fluid gets heated and pumped with the help of solar pump
* The working fluid gets condensed and cool, with the help of cooling towers and condensor
* In this heat engine the respretorzor is used which is used to collect the waste heat and uttize it efficiently

③ * Methods of Energy Storage of Hydrogen

* Storing of the hydrogen is quite challenging, because of its physical properties.
* It has high energy density in terms of its weight (3 times greater than gasoline)
* It has low energy density in term of its volume
* Hydrogen based vehicles should travel 470 km in between one fills hence storing of hydrogen requires more physical space than compared to fuels like petrol and diesel.

we have 2 procedures:-

(i) Compressed gass and liquid hydrogen storgage tanks
(ii) Material based storage.

* in first process we store the hydrogen in the reservoir or tanks by applying pressure
* second process has 2 types storing by
  a) adsorption
  b) absorption
* in adsorption the hydrogen molecules or atoms gets adsorbed on the surface of the material.
* in absorption the hydrogen molecule gets incorporated into the solid lattice framework

Based on the above observations we have 3 methods of hydrogen energy storage

1) Compression
2) Liquified hydrogen
3) Metal hydrides.

1) Compression:- The hydrogen are preserved in the large tanks or the underground preservoir.
* But the energy efficiency is poor around (60-75%)
* It is the conventional method of storing.

2) Liquified hydrogen:- The hydrogen are compressed under high pressure and cooling.
* It has more energy density compared to traditional methods. It is more efficient as well
* But the problem is it should be stored below the temperature 20.27K

3) Metal hydrides:-
* There are materials which can store the hydrogen gas such as nanostructured carbon.
* The hydrogen atoms are incoporated into them and

whenever required they are removed from the parent material.

* They are easy to transport and carry.
* They are same efficeint as liquified hydrogen.

(3)

(4) Wind characteristics :-

* Before installing the wind turbines, we need to keep in mind some of the wind characteristics, in order to yield the better output.
* The characteristics are:-
  - Mean wind speed
  - wind speed patterns
  - wind shear (profile)
  - turbelence and obstacles
* the above characteristics require some calculations and basic tools to measure their properties, But no calculation can compare the on site wind measuring campaigns.
  - The speed of the wind changes anually, diurnal, and seasonal patterns;
  - mean wind speed determines the parameters like height and length of the turbine.

* by having the proper equipment and the area of installation and keeping the characteristics of wind we can have the following benifits

→ Increases the efficency

→ Reduces the wear and tear of the internal part of turbine

→ Gives the longer lifetime for the machine

→ More output is yielded at

Guidelines for wind turbine site selection :

following guidlines should be taken care before installing

* Hill effect
* Tunnel effect
* wind shear effect
* Turbelence effect
* Disturbance from the obstacles
* Wind speed and direction

* Hill effect usually refers to direction and speed of the wind is very high in the top of the hill, it can be advantageous to set up the turbine at that place.

* In the tunnel effect the wind speed will increases when it come across the solid obstacles, hence when we set up wind mill in between the buildings and in between the 2 mountains it acts as a funnel, and wind speed will be more compared to the surrounding area.

* turbelence effect → turbelence is resistance in the air which causes slow down of the rotation of the rotor, it is reduced by setting the turbine and the proper design of the blades.

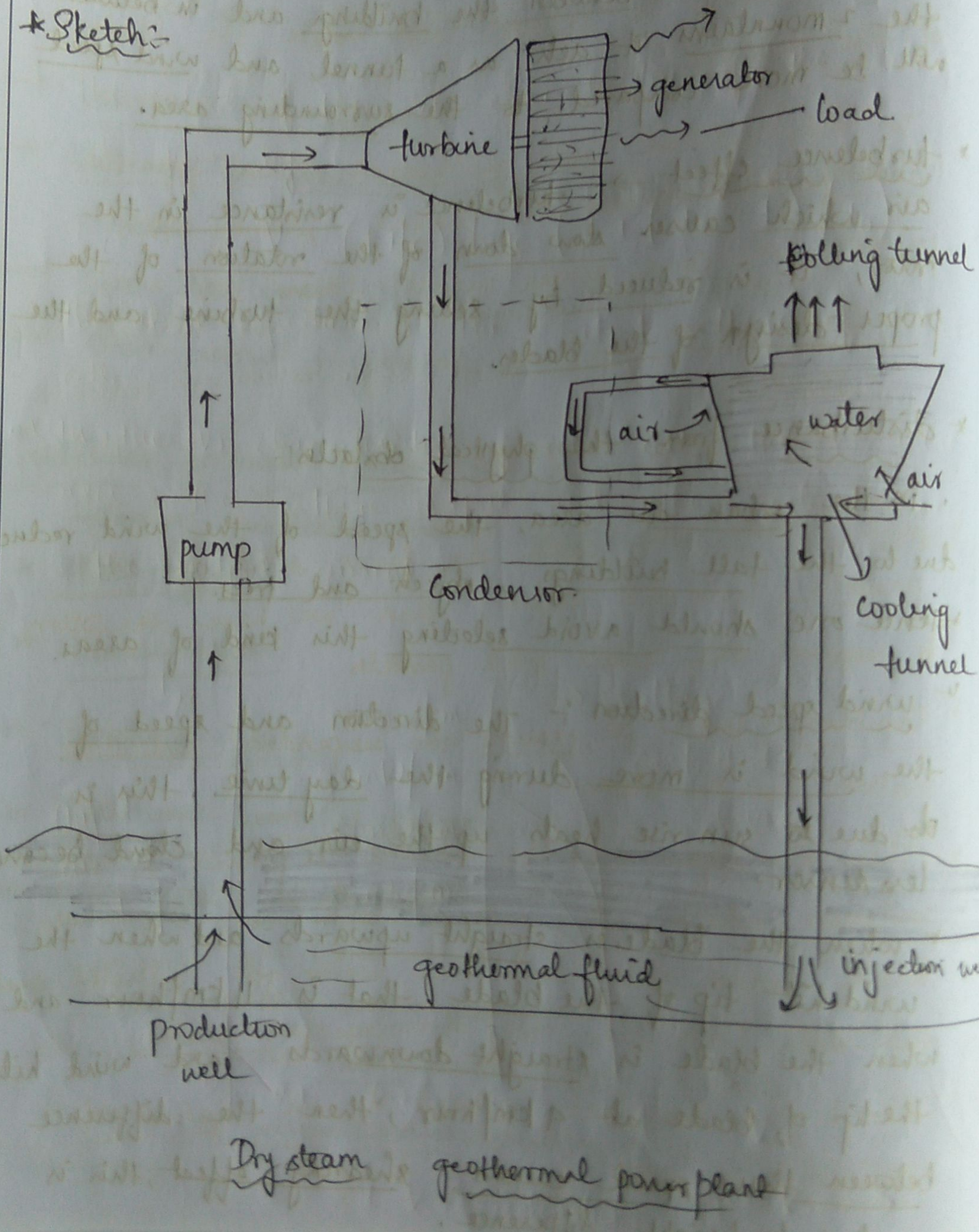
* disturbance from the physical obstacles:-
  - in the urban area, the speed of the wind reduces due to the tall buildings, objects and trees.
  - Hence one should avoid selecting this kind of areas.

- wind speed direction :- the direction and speed of the wind is more during the day time, this is due to sun rise heats up the air and cloud become less denser.

- when the blade is straight upwards and when the wind hit tip of the blade that is 11 km/hour and when the blade is straight downwards and wind hits the tip of blade at 9 km/hour, then the difference between their speed causes shearing effect, this is due to height difference.

(5) Dry steam based geothermal power plant

*Sketch:-



Dry steam geothermal power plant

* Explanation:

* In this geothermal power plant, the hydrothermal water is directly pumped into the turbine, this steam is used to expand and rotate the blades of the turbine.

* In this method the geothermal steam from the underground reservoir is pumped, during this pumping we come across several filters like.

- Rock catcher
- Scrubber
- Solid suspend remover

* Rock catcher will catch the large solid and rock particles from the steam, then we have the filter to remove the small solid particles.

* Scrubber is used to remove the suspended particulate matters from the steam

* Then the steam from the turbine is passed to the condenser which gets condensed and cool with the help of tunnel cooler and the water gets collected back the well with the help of injection well.

* This is the ~~fra~~ plants present in the Geyser of California. which are rare to find

(2)

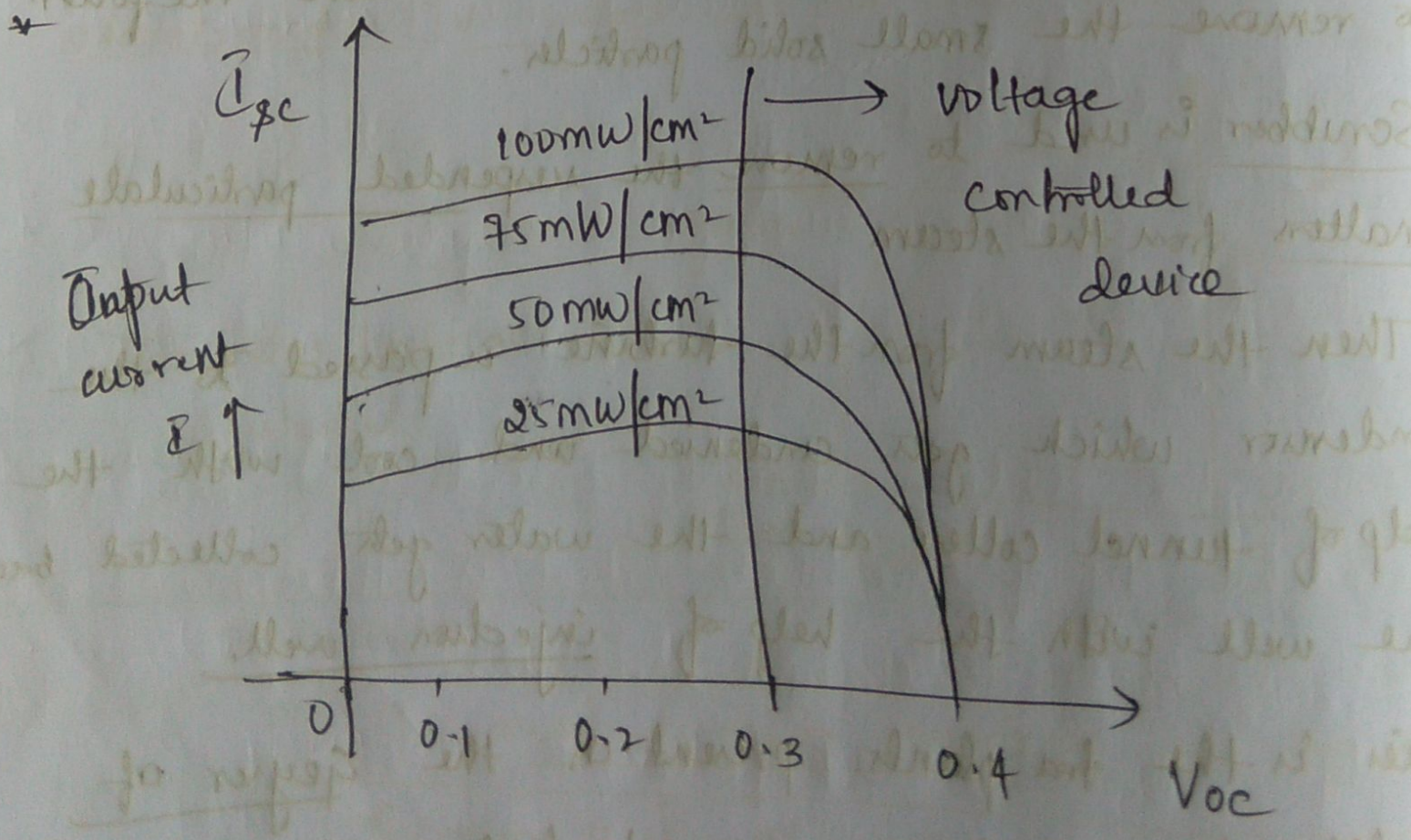
V-I characteristics of solar cell and maximum power point:-

* The output of the VI characteristics of the solar cell is given by

$$V = (KT/e) \log_e \left(1 + (\bar{I}_s - \bar{I})/\bar{I}_0\right) \rightarrow (1)$$

* The above equation is the output voltage of the solar cell.

* In the VI characteristics of solar cell, the horizontal axis is the voltage output and the vertical axis is the output current.



$\bar{I}$-V characteristics. Output V →

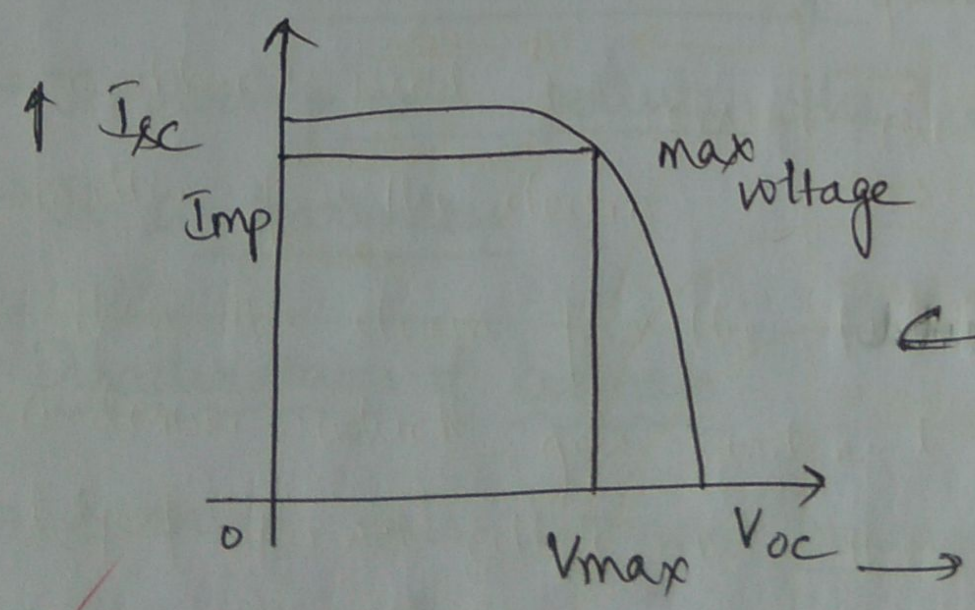
* in the IV characteristics we mainly come across the 2 characteristics

- short circuit current (I_{sc})
- Open circuit voltage (V_{oc})

* in the short circuit current, the positive and the negative terminals of the solar cell is shorted and voltage near them is zero, and load resistance is null.

* in the open circuit voltage, the voltage across the terminals of the solar cell, when the load resistance is infinity

* The ideal solar cell has the below VI characteristics



← ideal solar cell characteristics

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* to get the maximum power we have $P = VI$

$$P = (I_s - I_o)\left(\exp(ke/T)\log_e\{(I_s - I)/I_o\}\right) V.$$