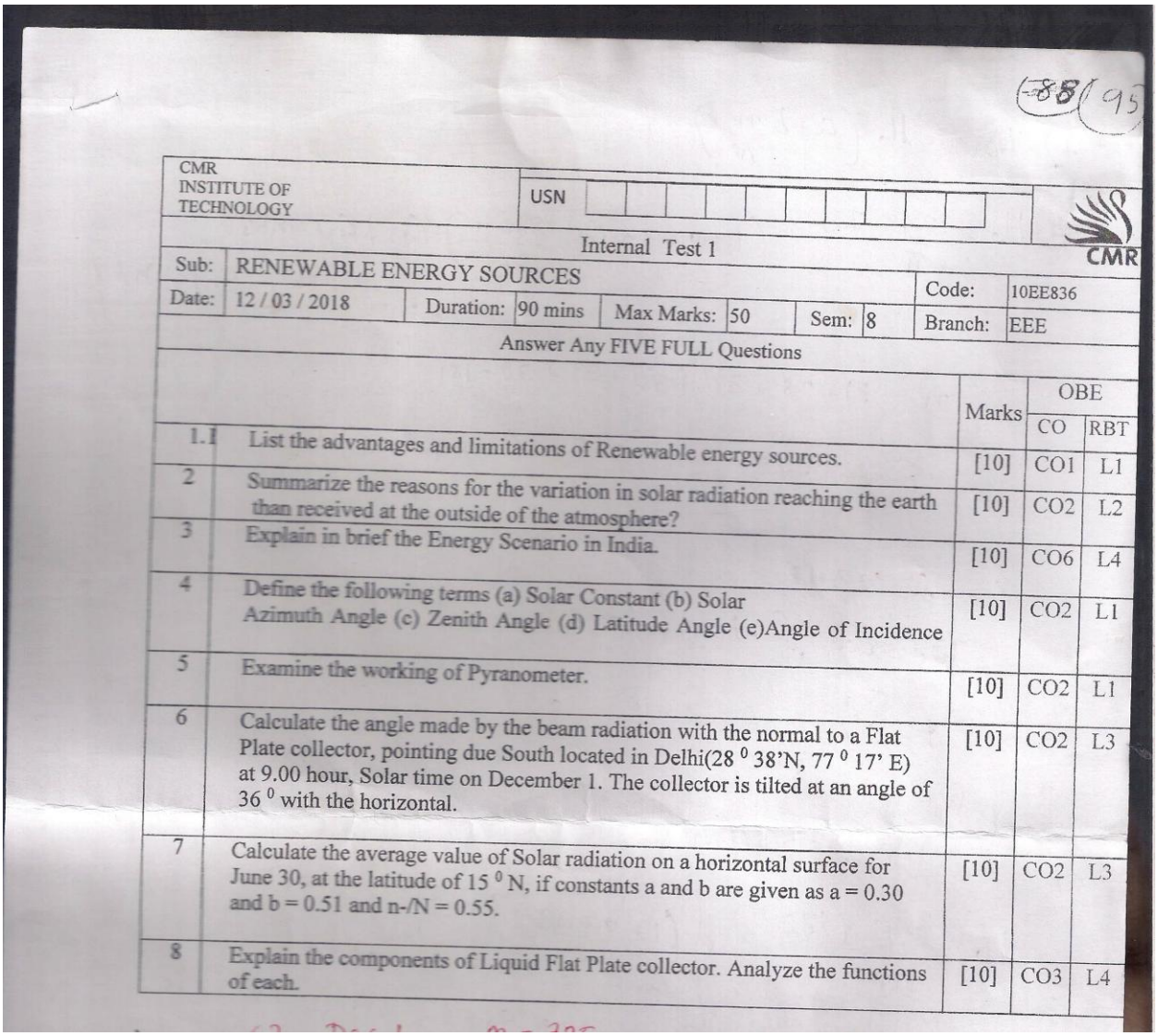


CMR INSTITUTE OF TECHNOLOGY

USN

Internal Test 1

Sub:	RENEWABLE ENERGY SOURCES					Code:	10EE836
Date:	12 / 03 / 2018	Duration:	90 mins	Max Marks:	50	Sem: 8	Branch: EEE

Answer Any FIVE FULL Questions

		Marks	OBE	
			CO	RBT
1.1	List the advantages and limitations of Renewable energy sources.	[10]	CO1	L1
2	Summarize the reasons for the variation in solar radiation reaching the earth than received at the outside of the atmosphere?	[10]	CO2	L2
3	Explain in brief the Energy Scenario in India.	[10]	CO6	L4
4	Define the following terms (a) Solar Constant (b) Solar Azimuth Angle (c) Zenith Angle (d) Latitude Angle (e)Angle of Incidence	[10]	CO2	L1
5	Examine the working of Pyranometer.	[10]	CO2	L1
6	Calculate the angle made by the beam radiation with the normal to a Flat Plate collector, pointing due South located in Delhi(28 ^{0} 38'N, 77 ^{0} 17' E) at 9.00 hour, Solar time on December 1. The collector is tilted at an angle of 36 ^{0} with the horizontal.	[10]	CO2	L3
7	Calculate the average value of Solar radiation on a horizontal surface for June 30, at the latitude of 15 ^{0} N, if constants a and b are given as a = 0.30 and b = 0.51 and n-/N = 0.55.	[10]	CO2	L3
8	Explain the components of Liquid Flat Plate collector. Analyze the functions of each.	[10]	CO3	L4

1.

Advantages – Solar energy

- The energy from the Sun is free.
- The sun does not produce greenhouse gases.
- The sun will always be there during our lifetime.

Disadvantages

- Solar panels are expensive.
- When it is cloudy or at night there is not enough light.

- Some people don’t like the look of solar panels.

Wind energy

Advantages

- Wind is renewable.
- Wind is free.
- No greenhouse gases are made.
- There are few safety risks.

Disadvantages

- Lots of wind turbines are needed to produce enough power.
- Turbines can only be put in windy areas.
- It is not always windy.

Biomass

Advantages

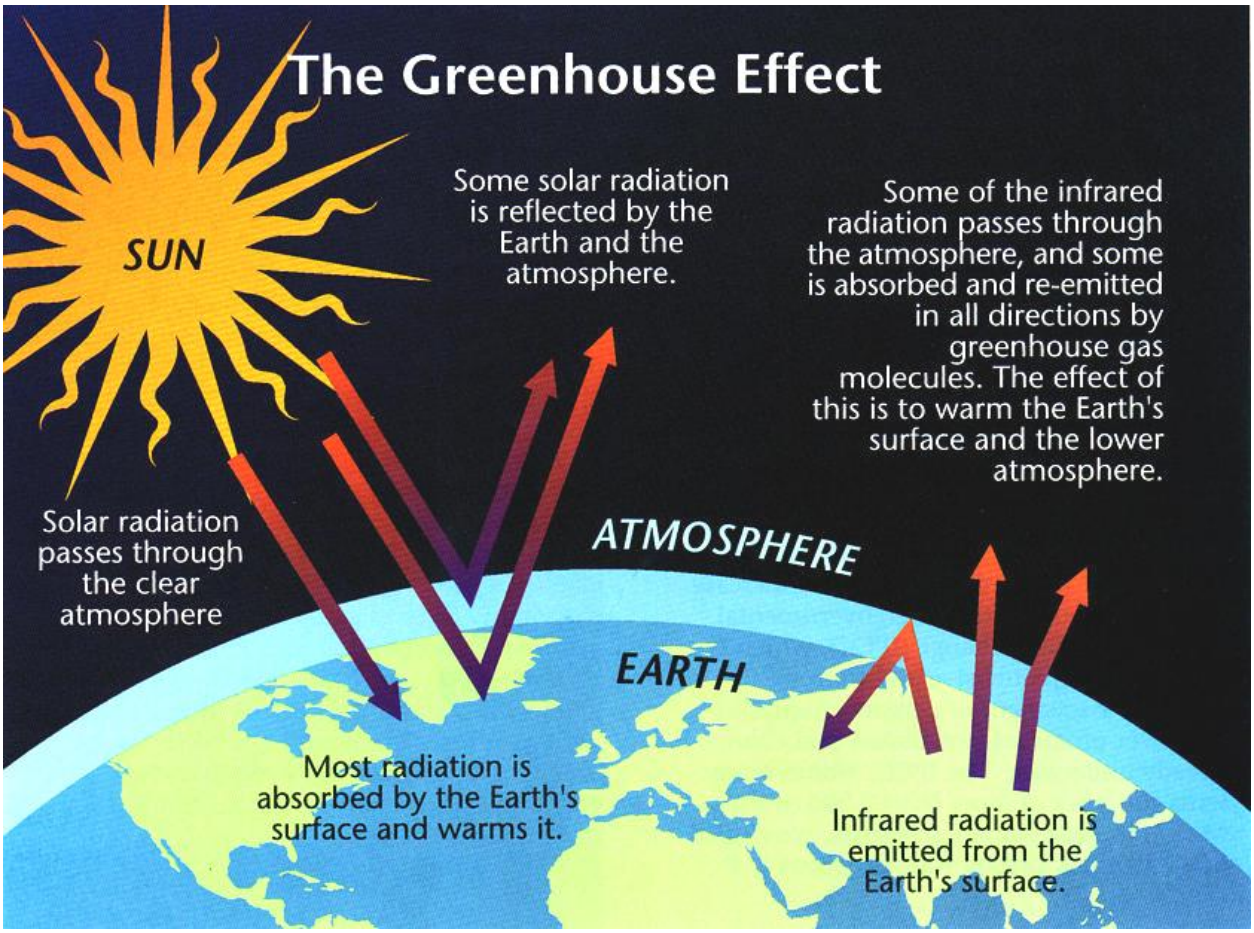
- Produces less pollution than fossil fuels.
- Does not cause acid rain.
- Can be found locally.
- It is renewable.

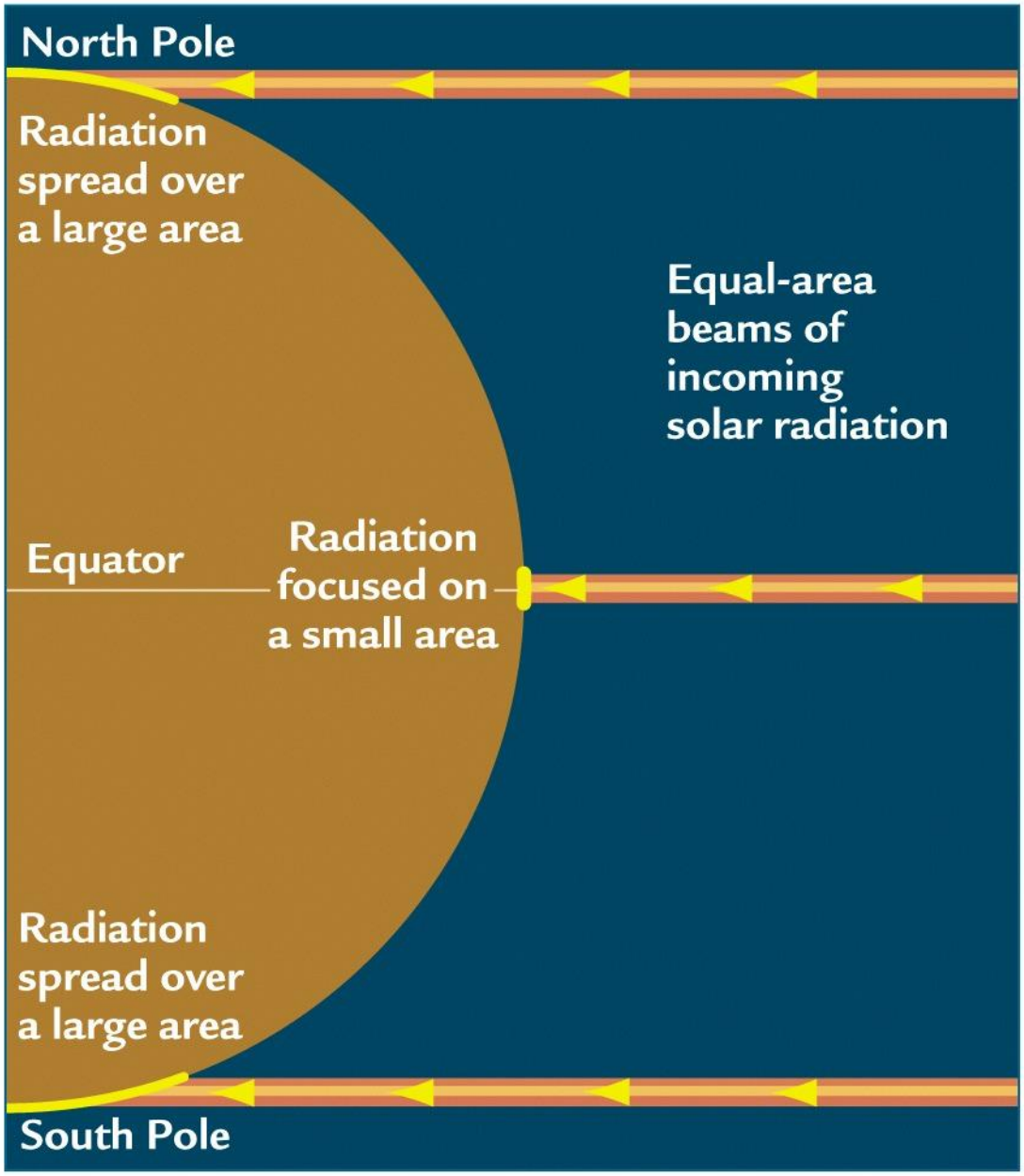
Disadvantages

- Inefficient (only 30% efficiency).
- Releases harmful solid carbon particles into the atmosphere.

----------(10 Marks)

2. Reasons for variation of Solar energy


The Greenhouse Effect
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere
ATMOSPHERE
EARTH
Most radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.



Insolation is stronger in the tropics (low latitudes) than in in the polar regions (high latitudes).

----------(10 Marks)

3. Energy scenario in India

- Electricity sector in India had an installed capacity of 250.256 GW as of July 2014.

- India became the world's third largest producer of electricity in the year 2013 with 4.8 % global share in electricity generation surpassing Japan and Russia.
- Captive power plants have an additional 39.375 GW capacity.
- Non – Renewable Power Plants constitute 87.55 % of the installed capacity.
- Renewable Power Plants constitute the remaining 12.45 % of total installed capacity.
- India generated about around 967,150.32 GWh of electricity during the 2013 – 2014.
- In terms of fuel coal – fired plants account for 59 % of India's installed electricity capacity, compared to South Africa - 92 %, China - 77 % and Australia - 76%.
- After coal, renewable hydro power accounts for 17%, renewable energy for 12% and natural gas for about 9%.
- The international agency estimates that India will add between 600 GW to 1200 GW of additional new power generation capacity before 2050.
- This added new capacity is equivalent to 740 GW of total power generation capacity of European Union in 2005.
- India's electricity is amongst the world's most active players in renewable energy utilization especially wind energy.
- India had 4.8 GW of installed generation capacity using nuclear fuels.
- India's Nuclear plants generated 32455 million units or 3.75% of total electricity produced in India.
- India's nuclear power plant development began in 1964 by commissioning of two boiling water reactors at Tarapur.

----------(10 Marks)

4. **Solar Azimuth angle(Ɣs)**

It is the angle on a horizontal plane between the line due south and the projection of the sun's ray on the horizontal plane. It is taken as positive when measured from south towards west.

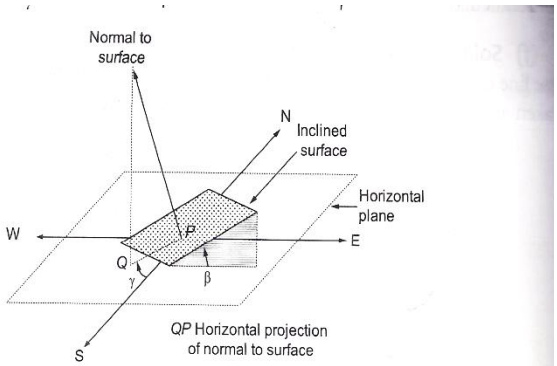


Fig. 4.17 *Surface azimuth angle and slope (tilt angle)*

Zenith angle , Θz :

It is the angle between the sun's ray and the perpendicular(normal) to the horizontal plane.

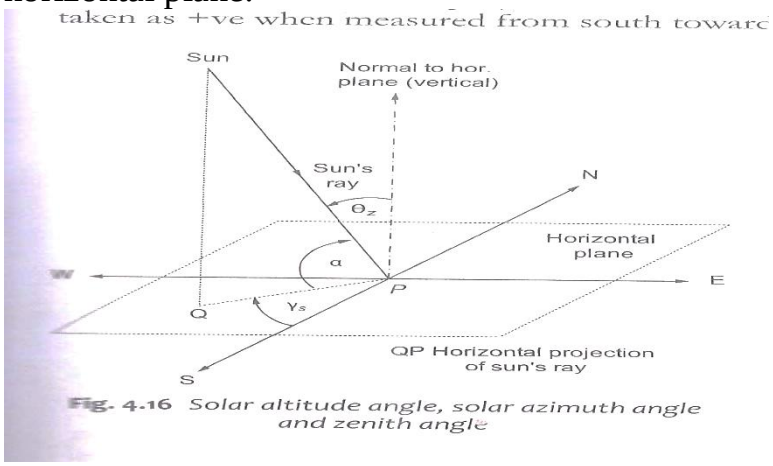


Fig. 4.16 *Solar altitude angle, solar azimuth angle and zenith angle*

Latitude(Angle of Latitude), (φ) :

The Latitude of a location on the earth's surface is the angle made by the a radial line joining the given location to the center of the earth with its projection on the equator plane The Latitude is positive for Northern hemisphere and negative for Southern hemisphere.

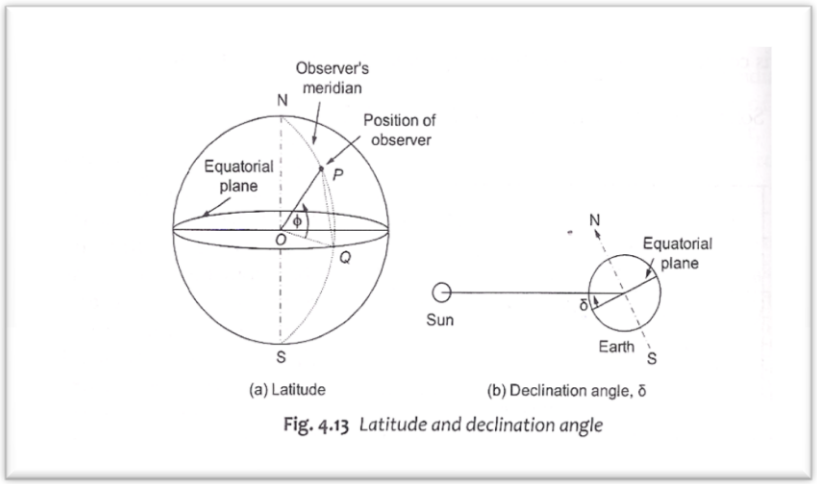


Fig. 4.13 *Latitude and declination angle*

Angle of Incidence,(Ɵi):

It is the angle between the sun's ray incident on the plane surface(collector) and the normal to the surface.

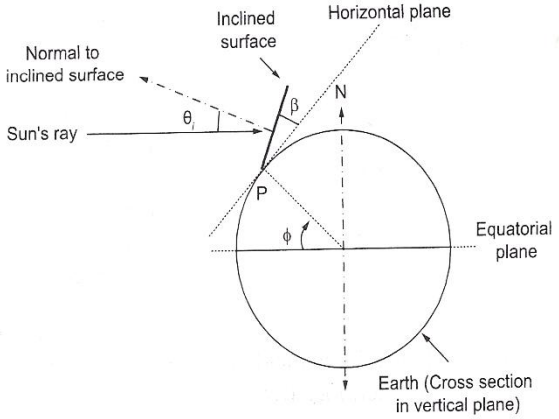
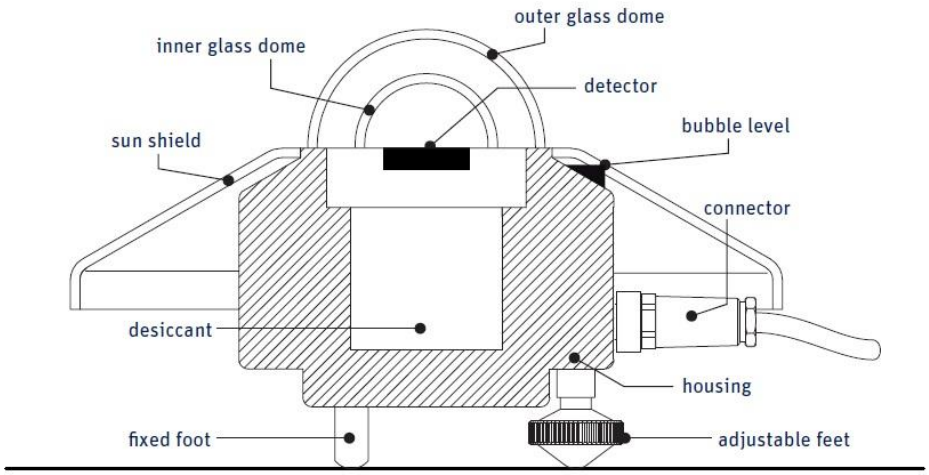


Fig. 4.18 *Angle of latitude, tilt angle, angle of incidence*

----------(10 Marks)

5. Working of Pyranometer

A Pyranometer is designed to measure global radiation usually on a horizontal surface, but can also be used on an inclined surface. When shaded from beam radiation by using a shading ring, a Pyranometer measures diffused radiation.



- A Pyranometer is used for measuring solar irradiance on a planar surface
- It is designed to measure the solar radiation flux density (W/m^2) from the hemisphere above within a wavelength range 0.3 µm to 3 µm
- The name Pyranometer is derived from pyr, meaning "fire" and ano meaning "above sky"
- A typical Pyranometer does not require any power to operate
- A Precision Pyranometer is designed to respond to radiation of all wavelengths and hence measures accurately the total power in the incident spectrum
- It contains a thermopile whose sensitive surface consists of circular, blackened, hot junctions exposed to the sun, the cold junctions being completely shaded
- The temperature difference between the hot and cold junctions is the function of radiation falling on the sensitive surface
- The sensing element is covered by two concentric hemispherical glass domes to shield it from wind and rain

----------(10 Marks)

6.

sors & Tra

Calculate the angle made by the beam radiation with the normal to a flat plate collector, pointing due south located in New delhi (28°38'N, 77°17'E) at 9:00 hour, solar time on dec 1. The collector is tilted at an angle of 36° with the horizontal.

'n' on dec 1, $n = 335$

$$\delta = 23.45 \sin\left[\frac{360}{365}(284+n)\right]$$

$$= 23.45 \sin\left[\frac{360}{365}(284+335)\right] = -22.11^\circ.$$

$$\boxed{\delta = -22.11}$$

$\beta = 36^\circ$. $\phi = 28^\circ 38' = 28^\circ.63$

γ = pointing due south - surface

$$\boxed{\gamma = 0}$$

ω = (solar time - 12:00) in hrs $\times 15^\circ$

$\omega = -45^\circ$.

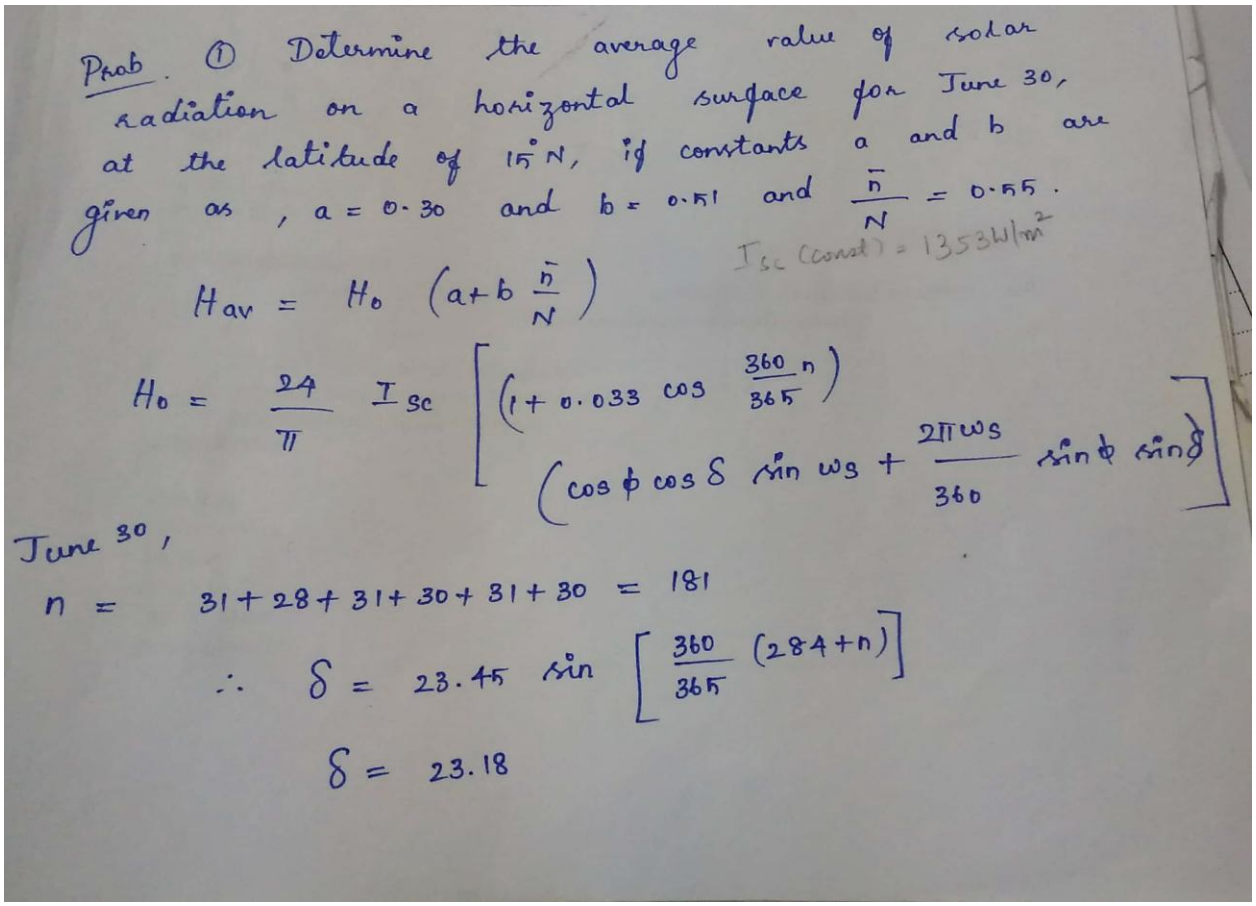
$$\cos\theta_i = \sin\delta \sin(\phi-\beta) + \cos\delta \cos\omega \cos(\phi-\beta)$$

$$= \sin(-22.11) \sin(28^\circ.63 - (36)) + \cos(-22.11) \cos -45 \cos(28.63-36)$$

$$= 0.0483 + 0.6496$$

$$\boxed{\theta_i = 15.7^\circ}$$

7.



Prob. ① Determine the average value of solar radiation on a horizontal surface for June 30, at the latitude of 15° N, if constants a and b are given as, $a = 0.30$ and $b = 0.51$ and $\frac{\bar{n}}{N} = 0.55$.

I_{sc} (const) = 1353 W/m²

$$H_{av} = H_o \left(a + b \frac{\bar{n}}{N}\right)$$

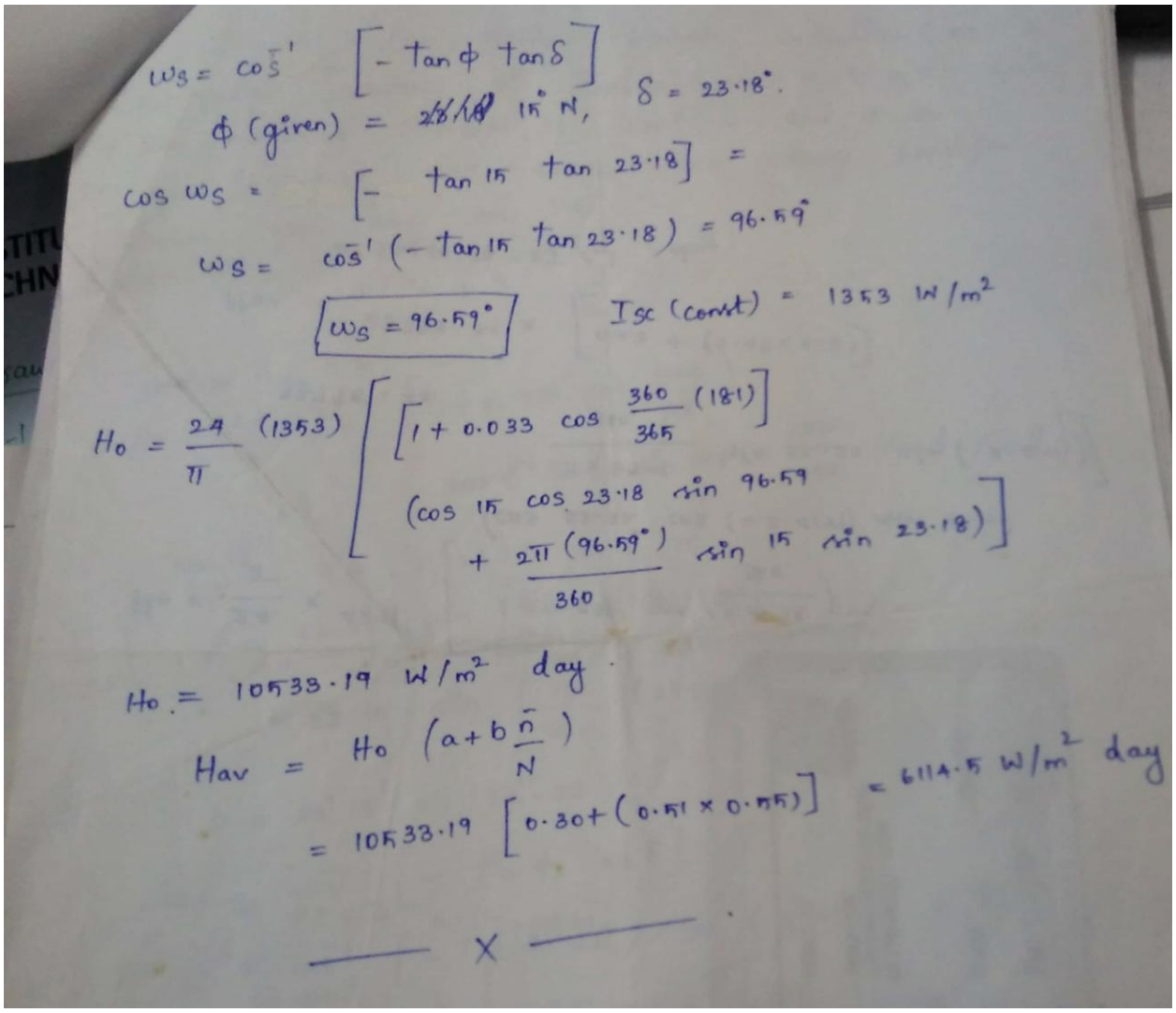
$$H_o = \frac{24}{\pi} I_{sc} \left[\left(1 + 0.033 \cos \frac{360}{365} n\right) \left(\cos\phi \cos\delta \sin\omega_s + \frac{2\pi\omega_s}{360} \sin\phi \sin\delta\right)\right]$$

June 30,

$n = 31 + 28 + 31 + 30 + 31 + 30 = 181$

$$\therefore \delta = 23.45 \sin\left[\frac{360}{365}(284 + n)\right]$$

$$\delta = 23.18$$



8. Solar collector

A solar thermal collector collects heat by absorbing sunlight. A collector is a device for capturing Solar Radiation. Solar radiation is energy in the form of electromagnetic radiation from the infrared (long) to the ultraviolet (short) wavelengths.

Liquid Flat Plate Collector

5.1.4 Liquid Flat-plate Collector

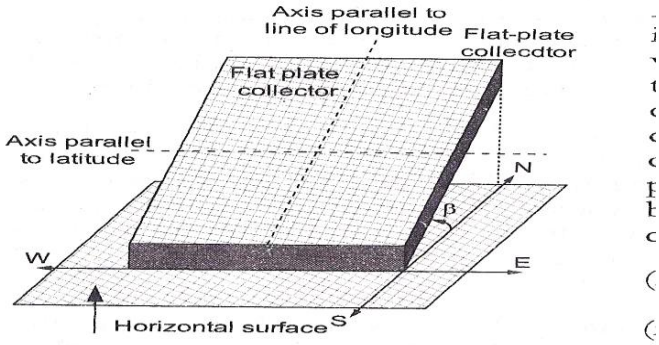


Fig. 5.2 *Positioning of flat-plate collector*

A flat-plate collector is placed at a location in a position such that its length aligns with the line of longitude and is suitably tilted towards South to have maximum collection.

Basic elements in collectors

1. Transparent cover(one or two sheets) of glass or plastic.
2. Blackened absorber plate usually of copper, aluminium or steel.
3. Tubes, channels or passages in thermal contact with the absorber plate.
4. Weather tight, insulated container to enclose the above components.

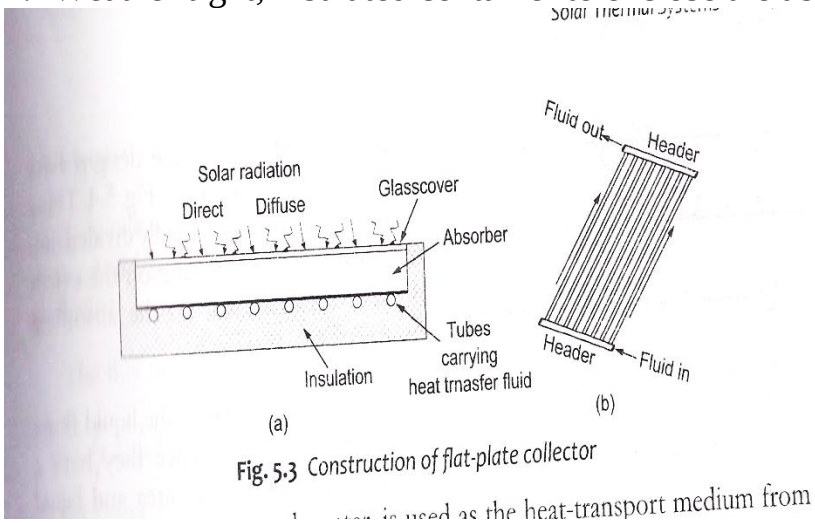


Fig. 5.3 *Construction of flat-plate collector*

heat-transport medium from

----------(10 Marks)