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CMRIT

Internal Assesment Test - I

Sub:	Renewable Energy Systems							Code:	18EE653
Date:	13/05/2022	Duration:	90 mins	Max Marks:	50	Sem:	6th	Branch:	CSE/ISE/ECE/MECH

Answer Any **FIVE FULL** Questions. Question no**. 3 is compulsory**.

			Marks	OBE	
				CO	RBT
1.	a	Write short notes on the layers of the sun.	5	CO2	L1
1.	b	Discuss about the causes of energy scarcity.	5	CO1	L2
2.	a	Define (i) Hour angle (ii) latitude angle (iii) Zenith angle	3	CO2	L1
2.	b	Define Energy and energy resources. Discuss different ways of their classification with examples in each category	7	CO1	L1
3.	a	Calculate zenith angle of the sun at Lucknow (26.750 N) at 9:30 am on February 16, 2012.	5	CO2	L3
3.	b	Find the solar altitude angle at 2 hour after local solar noon on 1 st June 2012 for a city, which is located at 26.75°N latitude.	5	CO2	L3

P.T.O

| 4.	a	List the differences between renewable and non-renewable energy sources.	4	CO1	L1
4	b	State the advantages and disadvantages of concentrating collectors over flat plate collectors.	6	CO3	L1
5.	a	What are the main components of a flat plate solar collector? Explain the function of each component.	8	CO3	L2
5	b	State and explain solar constant.	2	CO2	L2
6	a	Explain briefly the Indian renewable energy scenario and its availability.	6	CO1	L2
6	b	What are the advantages and limitations of renewable energy sources?	4	CO1	L1

CCI   **HOD**

QP Solution

Q.1 a Write short notes on the layers of the sun.

ANATOMY OF THE SUN
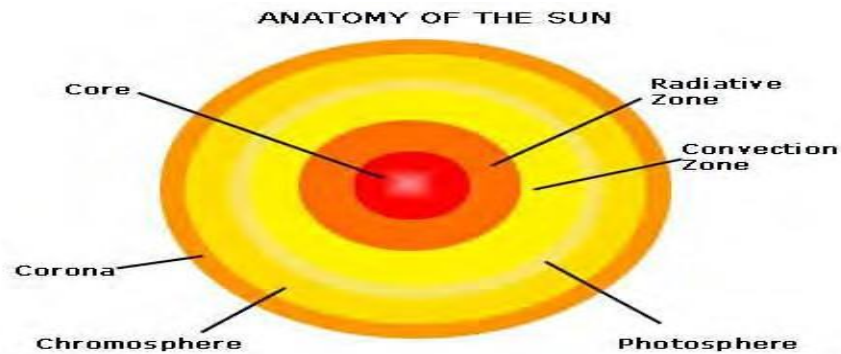
Solar envelope

- Radiative envelope surrounded by convective envelope
- Temp is 4 million Kelvin
- Less dense than core
- 60% mass in 90% volume
- Puts pressure on core and maintains core temperature
- Cooler and More Opaque than core

Photosphere

- Zone from which sunlight is seen and emitted
- Thin layer of low pressure gases
- 6000 degree celcius

Chromosphere

- A red circle can sometimes be seen outside the sun during eclipse which is called chromosphere
- Hydrogen abundant so red in colour
- 7000 K, hotter than photosphere

Corona or Crown

- The outermost layer of the sun
- Thin and faint so difficult to observe from the earth
- Visible during total solar eclipse
- Outer layer is very dim
- It is the hottest 10^6K layer though Spreads over several million kilometers into space, lots of room for molecules to move, Causes Solar winds

Q. 1 b Discuss about the causes of energy scarcity.
  a. Increasing Population
  b.   Increase Energy Usage or Consumption
  c.   Uneven Distribution of Energy Resources
  d.   Lacks of Technical Knowhow
  e.   Poor Infrastructure at power generating stations
  f.   Unexplored Renewable Energy Options
  g.   Delay in Commissioning of Power Plants
  h.   Wastage of Energy
  i.   Poor Distribution System
  j.   Major Accidents and Natural Calamities
  k.   Wars and Attacks
  l.   Miscellaneous Factors-strikes, military coup, political events, severe hot summers or cold winters.

Q. 2 a Define (i) Hour angle (ii) latitude angle (iii) Zenith angle

Hour angle is the angular distance between the meridian of the observer and whose plane contains sun.

latitude angle : Angle between line drawn on a point from earth's surface to the center of earth and the earth's equitorial plane.

Zenith angle: The solar zenith angle is the angle between the sun's rays and the vertical direction. Complement of solar altitude angle

Q. 2 b. Define Energy and energy resources. Discuss different ways of their classification with examples in each category

Energy is the capacity of a physical system to perform work. It exists in several forms such as heat, mechanical(potential and kinetic), light, electrical, or other forms of energy.

Energy resources are defined as any material object containing energy in abundance and transferrable to usable energy form.

Classification of Energy Resources
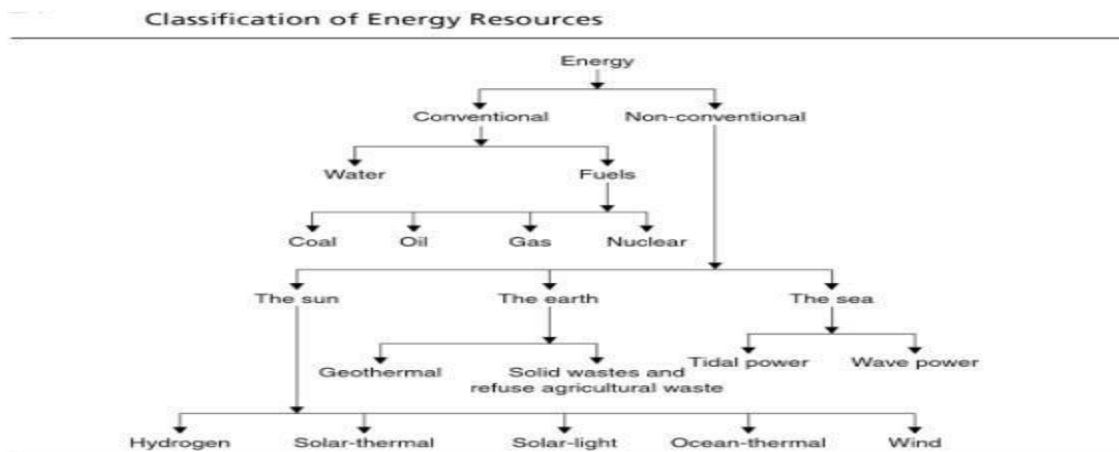
Q. 3 a Calculate zenith angle of the sun at Lucknow (26.750 N) at 9:30 am on February 16, 2012.

- Calculate zenith angle, of the sun at Lucknow (26.75° N) at 9:30 am on February 16,2012

- $\delta = 23.45 \sin [360 (284+n)/365]$

  $n = 31+16 = 47$

  $\delta = -12.95° = -13°$

- Hour angle ω

  $\omega = (1/4) tm$

  $tm = 12.00 - 9.30 = (12*60) - (9*60) + 30 = 720 - 570 = 150$ min

  $\omega = \frac{150}{4} = -37.5$

- $\phi = 26.75$

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

- $\theta_z = 53.914$

Q. 3 b Find the solar altitude angle at 2 hour after local solar noon on 1 st June 2012 for a city, which is located at 26.75°N latitude.

- Declination angle $\delta = 23.45 \sin [360 (284+n) / 365]$

  $n = 31+29+31+30+31+1 = 153$

  $\delta = 22.17°$

- The hour angle $\omega = (1/4) tm = (1/4) 120 = 30°$

- Solar Altitude Angle α

  Zenith angle $\theta Z = 90 °- \alpha$

  $\cos \theta Z = \cos (90 °- \alpha) = \sin \alpha$

  $\sin \alpha = \cos\phi \cos\delta \cos\omega + \sin\phi \sin\delta$

  $= \cos26.75° \cos22.17° \cos30 ° + \sin26.75° \sin22.17 °$

  $\sin \alpha = 0.88265$

  $\alpha = 62.4 °$ (approx)

- The daylight hour $= 2TH =$ sunrise time + sunset time

  $=2* (1/15)\cos^{-1} (-\tan\phi * \tan \delta)$

  $=2* (1/15)\cos^{-1} [-\tan(26.75°) * \tan (22.17°)]$

  $= 10.43$ h

- Sunrise time $= 12-(10.43/2) = 6.785$ h$= 6: 48$ am

- Sunset time $= 12 + (10.43/2) = 17.215h=17:12$ pm

Reference   0.785 h* 60 = 48 min

0.215 h * 60 = 12 min

Q. 4 a List the differences between renewable and non-renewable energy sources.

Primary energy resources may be further sub-classified as follows:
Renewable energy resources
Continuously restored by nature
 Solar, water and wind etc,.
Non-renewable energy resources
Reserve that is once accumulated in nature has practically ceased to form
Under new geological conditions.
Expendable energy
Coal, oil, gas and nuclear etc.,

Q.4 b State the advantages and disadvantages of concentrating collectors over
flat plate collectors.
Advantages

- Reduces the   size of absorber
- Reduce heat losses
- Increases efficiency at high temperature
- Used for high temperature applications such as steam production for electricity
- Best suited for climates that have abundance of clear sky days

Disadvantages
a. High Costs
b. Ecological and Cultural Issue
c. Since concentrators can focus only direct solar radiation, this performance is poor on cloudy days.
d. Tracking mechanisms must be used to move the collectors during the day to keep then focused on the sun.
e. Maintaince and construction costs of the system are high.
f. Concentrators are only practical in areas of high direct insolation, such as arid and desert areas.

Q.5 a What are the main components of a flat plate solar collector? Explain the function of each component.

- Dark flat Plate Absorber of Solar energy
- ---consists of thin absorber sheet of thermally stable materials such as Al,Cu,steel,etc..
- Transparent Cover
- ---allows solar energy to pass through, but reduces heat losses
- ---reduces convection and radiation losses from
- absorber plate
- Heat Transport Fluid
- --air, water or antifreeze
- --To remove heat from absorber, fluid is usually circulated through tubing to transfer heat from absorber to an insulating tank

- Heat Insulation Backing
- Insulated casing of glass or polycarbonate cover
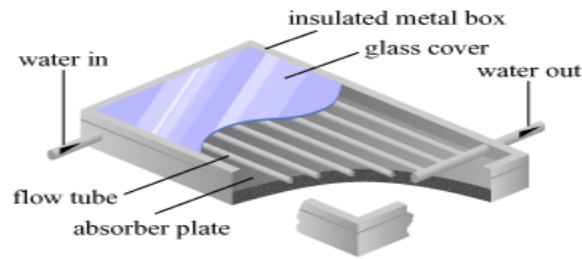
Q.5 b State and explain solar constant.

Solar constant: It is a measure of flux density and it is amount of incoming solar electromagnetic radiation per unit area that would be incident on a plane perpendicular to the ray sat a distance of one AU. It includes all type of solar radiation not only visible light. Average value-1366 w/m^2

Q.6 a Explain briefly the Indian renewable energy scenario and its availability.

India is one of the countries with the largest production of energy from renewable sources.

In the electricity sector, renewable energy account for 34.6% of the total installed power capacity.

Large hydro installed capacity was 45.399 GW as of 30 June 2019, contributing to 13% of the total power capacity.

The remaining renewable energy sources accounted for 22% of the total installed power capacity (80467 GW) as of 30 June 2019.

Wind power capacity was 36,625 MW as of 31 March 2019, making India the fourth-largest wind power producer in the world.

The country has a strong manufacturing base in wind power with 20 manufactures of 53 different wind turbine models of international quality up to 3 MW in size with exports to Europe, the United States and other countries.

Wind or Solar PV paired with four-hour battery storage systems is already cost competitive, without subsidy, as a source of dispatch able generation compared with new coal and new gas plants in India.

The government target of installing 20 GW of solar power by 2022 was achieved four years ahead of schedule in January 2018, through both solar parks as well as roof-top solar panels.

India has set a new target of achieving 100 GW of solar power by 2022.

Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy (MNRE). India was the first country in the world to set up a ministry of non-conventional energy resources, in the early 1980s.

Solar Energy Corporation of India is responsible for the development of solar energy industry in India. Hydroelectricity is administered separately by the Ministry of Power and not included in MNRE targets.

In the 2027 forecasts, India aims to have a renewable energy installed capacity of 275 GW,

In addition to 72 GW of hydro-energy, 15 GW of nuclear energy and nearly 100 GW from "other zero emission" sources

Q.6 b What are the advantages and limitations of renewable energy sources?
Advantages
- Available abundantly in nature
- They cause no pollution and hence environment friendly
- They are inexhaustible
- Low gestation period

Limitations
- Though freely available cost of harnessing them is generally very high
- Availability is uncertain, since it is dependent on natural phenomenon
- Difficult in transporting such forms of energy