Assignment -1

(To be done **after** studying the course material)

Course Code: MRW-005
Course Title: Solar Energy and Applications
Assignment Code: MRW-005/TMA/2026
Maximum Marks: 100

Last Date of Submission: April 30, 2026 (For June TEE), September 30, 2026 (For December TEE)
Note:

1. **For any question worth 5 marks the word limit is 200 words, for a 10 mark question it is 350 words.**

2. **All questions are compulsory. All questions carry equal marks.**

Q.1	a)	Explain Planck's law, Stefan Boltzmann law of thermal radiations.	5
	b)	Describe various component of Solar radiation. Discuss and draw spectral energy distribution of solar radiation at extra-terrestrial and terrestrial.	5
Q.2	a)	Discuss the process through which the Earth-atmosphere system maintains heat balance.	5
	b)	Describe basic parameters and characteristics of a solar cell.	5
Q.3	a)	What are the major difference between commercially available mono crystalline and polycrystalline silicon cells?	5
	b)	State various losses in the solar cell and module.	5
Q.4		Explain classification of solar thermal conversion.	10
Q.5		Explain the function of stand-alone solar PV system with and without battery with neat block diagram?	10
Q.6		List the various steps involved in the design of solar PV system.	10
Q.7		What is Solar Photovoltaic thermal (PVT). Explain its function with neat diagram.	10
Q.8	a)	Draw the diagram of wind- solar PV hybrid system and explain its working.	5
	b)	What are the key points to be considered during the operation of Solar Water Pump?	5
Q.9	a)	Explain the working principles of Solar Air Heating Systems.	5
	b)	Describe the concept of direct gain heating and cooling of solar passive buildings.	5
Q.10	c)	Describe the functioning of a solar dryer. Explain dehydration of Onion.	5
	d)	Explain Green Building. Are green buildings environment friendly.	5

Q.1 a) Explain Planck's law, Stefan Boltzmann law of thermal radiations. (5)

Answer

Thermal radiation is electromagnetic energy emitted by matter because of its temperature. Two basic laws used to describe this radiation are Planck's law and the Stefan-Boltzmann law. Planck's law gives the distribution of radiation with wavelength, while the Stefan-Boltzmann law gives the total energy emitted over all wavelengths.

Planck's law states that the monochromatic or spectral emissive power of an ideal black body depends on its absolute temperature and wavelength. One common form is: $E\lambda,b = (2\pi hc^2/\lambda^5) / [\exp(hc/\lambda kT) - 1]$, where h is Planck's constant, c is the velocity of light, k is Boltzmann's constant, λ is wavelength and T is absolute temperature. The law shows that a hot body does not emit the same amount of energy at every wavelength. Its spectrum has a definite peak. As temperature increases, the peak becomes higher and shifts towards a shorter wavelength. The Sun, because of its high surface temperature, therefore emits strongly in the visible and near-infrared region.

The Stefan-Boltzmann law is obtained by integrating the black-body spectrum over all wavelengths. It states that the total emissive power of a black body is proportional to the fourth power of its absolute temperature: $Eb = \sigma T^4$, where $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^{-4}. For a real surface, $E = \varepsilon\sigma T^4$, where ε is emissivity. Net radiative exchange with surroundings at temperature Ts may be written approximately as $q = \varepsilon\sigma A(T^4 - Ts^4)$.

These laws are important in solar-energy calculations. Planck's law explains the spectral character of sunlight and thermal emission from collectors, while the Stefan-Boltzmann law is used to estimate radiative heat loss from absorbers, receivers and other hot surfaces.