Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
B.E./B.Tech (Full Time) - END SEMESTER EXAMINATIONS, Nov/Dec 2024

MECHANICAL ENGINEERING
(Seventh Semester)

ME5016 SOLAR ENERGY TECHNOLOGY

(Regulation 2019)

Time: 3hrs Max.Marks: 100

Instructions: 1. State clearly any assumption made with justification

CO 1	Understanding the basics of solar radiation and types of solar collectors.
CO 2	Outlining the working of solar thermal systems and their applications.
CO 3	Inferring the fundamentals of solar PV systems and performance evaluation.
CO 4	Evaluating Solar PV systems design and its economic analysis.
CO 5	Understanding the basics of solar passive architectureand its performance.

BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	What is meant by the solar energy factor in a solar water heater?	2	CO1	L1
2	Define declination and when this angle becomes zero..	2	CO1	L1
3	What is the typical cost solar still and mention the limitations of solar still.	2	CO2	L1
4	What is the principal of solar thermal energy collection and how is it different from solar PV?	2	CO2	L1
5	Which solar material is mostly preferred for building façade and why?	2	CO3	L2
6	What is PERC solar cell? Highlight its features.	2	CO3	L1
7	Emphasize the growing significance of the Solar PV market in a Global context.	2	CO4	L2
8	What do you mean by Maximum Power Point Tracking (MPPT)?	2	CO4	L1
9	What do you mean by Ground coupling in solar house cooling system?	2	CO5	L1
10	Mention the objectives of green buildings.	2	CO5	L1

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a) (i)	Classify the solar collectors and discuss the function of evacuated tube solar collector.	8	CO1	L4
(ii)	Discuss the construction of sun path diagram.	5	CO1	L4
	OR			
11 (b)	What is Pyranometer and explain its working principle using simple sketch. Also list the use of Pyranometer.	13	CO1	L4
12 (a)	What is community solar cooker? Discuss the procedures involved in calculating the simple payback period for a solar cooker used to replace LPG cylinder.	13	CO2	L4
	OR			

12 (b)	Why Thermal Energy Storage (TES) is preferred for Solar energy systems? Discuss the merits and demerits of sensible and latent heat storage systems.	13	CO2	L4
13 (a) (i)	What are the different solar photovoltaic technologies? Sketch the parts of a typical solar cell and explain their role.	8	CO3	L4
(ii)	What is a Solar PVT system, and what are the various cooling options adopted in a PVT system?	5		
	OR			
13 (b)	Compare the energy band diagram of conductor /insulator / Semiconductor and discuss the necessity of doping for Si material. Also discuss how the PN junction of a solar PV panel produces electricity. (8+5)	13	CO3	L4
14 (a) (i)	Discuss the need for and functions of the Balance of System (BOS) in a solar photovoltaic (PV) unit.	8	CO4	L5
(ii)	What is fill factor? Calculate the fill factor for a solar cell which has the following parameters: Open circuit voltage = 0.2 V, Short circuit current = 5.5 mA, max. voltage = 0.125 V and max. current = 3 mA	5		
	OR			
14 (b)	A house uses 4 bulbs each 40 W (8 hours a day). 1 fan of 200 W (12 hours a day) and an electric heater 1500 W (1 hour a day). The house is to be electrified with solar panels. Calculate the current monthly bill for that house and also estimate the number of solar panels required for electrification.	13	CO4	L5
15 (a)	With neat sketches explain the concept of indirect gain solar passive heating of buildings.	13	CO5	L4
	OR			
15 (b)	What are the different solar cooling methods for buildings, and explain the working principle of any two methods?	13	CO5	L4

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16. i)	Evaluate the beam radiation tilt factor for a surface located at 30°N latitude and tilted 40° at 3.00 PM solar time on April 10. If the beam radiation at normal incidence is 850 W/m^2, calculate the beam radiation on the tilted surface. (5)	15	CO1	L5
ii)	It has been decided to install a solar water heater (SWH) in a hostel located in Chennai, where the hot water demand is estimated at 5000 liters per day, and the required hot water temperature is 75°C. Under these conditions, estimate the area of the SWH. Furthermore, assuming the SWH price is Rs. 5000 per m^2, calculate the number of years required to recover the amount incurred for the installation of the SWH. Assume one unit of electricity price is 4 rupees. (10)		CO2