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

Anna University (University Departments)

B.E. (Full Time) – ARREAR EXAMINATIONS, MAY 2024

Mechanical Engineering

VIII – Semester

ME 5016 : Solar Energy Technology

(Regulation 2019)

Time: 3hrs **Max.Marks: 100**

COURSE OBJECTIVES

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 architecture and 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)

(Use of approved Hand-outs / Tables / Charts are permitted)

Q.No	Questions	CO	BL
1	Define Solar Time	1	L1
2	What is the purpose of pyranometer and sun shine recorder?	1	L2
3	How do you estimate the concentration ratio of solar collector?	2	L1
4	Draw the Schematic diagram of a membrane based solar desalination cycle	2	L2
5	Outline the semiconductor parameters that determine the design and performance of a solar cell.	3	L2
6	Define (i) Maximum Power Point (ii) Fill factor	3	L1
7	What are the components of solar photovoltaic system?	4	L3
8	What is the disadvantage of connecting solar panels in parallel?	4	L2
9	Explain the use of bioclimatic chart.	5	L1
10	List down the solar passive heating systems employed in cold climate,	5	L2

PART – B (5 x 13 = 65 Marks)

Q.No	Questions	CO	BL
11(a)	Find the instantaneous solar radiation at 12:00 Noon (LAT) on a solar collector surface ($\beta = 15^{o}$) facing due south on June 21 in Chennai, Tamil Nadu	1	L3
	OR		
11(b)	With respect to Concentrating Solar collectors discuss (i) its tracking mechanism (ii) maximum concentration ratio and (iii) performance for any applications of your choice.	1	L4
12 (a)	Discuss various types of thermal storage system employed in a commercial solar water heating system and explain how you will estimate the tank temperature while in operation.	2	L5

	OR		
12 (b)	Explain the operation of any one type solar cooling system and discuss the procedure followed to estimate TEWI (Total Equivalent Warming Impact)	2	L5
13 (a)	(i) Explain the physics behind the formation of semiconductor junctions for the operation of solar cell. (7) (ii) Draw the typical I V curve for a solar Panel and discuss the effect of increased temperature or irradiance on the I-V curve (6)	3	L2
	OR		
13 (b)	(i) Derive the equation to find efficiency of ideal solar cell. (7) (ii) A SPV module having total area of 2 m^2 and gives a current of 8.12 A and voltage of 29.80 V at maximum power point. The short circuit current of the module is 8.53 A and open circuit voltage is 37.45 V. What is the fill factor, maximum power point and efficiency of the solar cell? Consider STC (6)	3	L4
14 (a)	Design a solar PV system for a commercial office which contains 10 fans of 40 watts each running for 8 hours a day, 40 tube lights of 24 watts each running for 8 hours a day and a 4 refrigerator of 250 watts running for 8 hours a day. Consider 2 day autonomy for battery.	4	L5
	OR		
14 (b)	Clearly distinguish between standalone, hybrid and grid connected PV system and discuss its tracking, system installation, operation and maintenance strategies for its operation for about 20 years.	4	L4
15 (a)	What do you meant by the term " Thermal Comfort"? List the parameters important to achieve the same in School building and explain how you will achieve the optimum thermal comfort using passive architecture design.	5	L5
	OR		
15 (b)	Explain the concept of Passive cooling techniques applicable to various climatic zones of India and discuss the suitable concept for any particular zone.	5	L3

PART – C (1 x 15 = 15 Marks)

Q.No	Questions	CO	BL
16	An industry requires 5000 kg/h of hot water per day at 65°C as process heat requirements for about 14 h/day. The following data are available for the location: (a) Annual average daily global radiation on the horizontal surface: 5.5 kWh/m^2 (b) Average ambient temperature : 26°C. What kind of Solar thermal system you recommend? Based on your recommendation estimate collector area, investment cost and payback period of the system considering you are replacing conventional diesel fired hot water generator for the same purpose. Assume the missing data with suitable reasoning.	1/ 2	L6