GUJARAT TECHNOLOGICAL UNIVERSITY

Minor Degree – Energy
Subject Code: N115AP02
Semester – 5 (w.e.f. AY 2025-26)
Subject Name: Solar Energy and Utilization

Prerequisite: Nil

Rationale:

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	0	30	0	100

Content:

Sr. No.	Content	Total Hrs
1	**Solar Radiation:** Need, merit, demerit and current scenario of solar energy, Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements.	06
2	**Solar Non-Concentrating Collectors:** Introduction and classification of solar non-concentrating collector, Transmissivity-Absorptivity product, Overall losses and heat transfer coefficient and its calculation using empirical correlations in solar flat plate collector, Evacuated solar collector, Solar air-heater, Performance of solar flat plate collector and solar air-heater, Effect of various parameters on the performance of collector.	10
3	**Solar Concentrating Collectors:** Introduction and classification of solar concentrating collector, Tracking modes and performance of cylindrical parabolic collector, tracking requirement and performance of compound parabolic collector, Calculation of overall loss coefficient for concentrating collector, Effect of various parameters on the performance of collector.	07
4	**Solar Thermal Applications:** Solar water heating system - active and passive, Solar space heating system - active and passive, Solar cooling system - absorption and adsorption refrigeration system, Solar desalination systems – solar stills, Solar dryer, Solar Cooker, Introduction and basic fundamentals of energy storage - sensible, latent heat and thermo- chemical storage.	05
5	**PV Cells:** Working of Solar cell, Crystalline silicone solar cells – production of silicon wafers, Fabrication of solar cells, Thin film solar cells, transparent conducting oxides, III-V PV technology, Thin Film silicon technology, Organic	07

	photovoltaic, Hybrid organic-Inorganics solar cells, Third and fourth Generation Concept, Present and proposed PV cells, Different materials for crystalline and Thin film solar cell, Properties of crystalline and thin film solar cells.	
6	**Introduction to PV Systems:** Status and prospects of PV Systems, Location issue – position of sun – sun path, PV cell – module – array, Irradiation on PV module, Shadowing, Maximum power point tracking, Types and component of PV system, PV system load and availability, Associated electronic components, Generators – types and size – characteristics, maintenance - selection, Wiring and code compliance, Balance of system, basics of PV design – load profile – Meteorological effect	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
14	**14**	**28**	**14**	**0**	**0**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Solar Energy – Principles of Thermal Collection and Storage, S. P. Sukhatme, McGraw Hill.
2. Solar Engineering of Thermal Processes, J. A. Duffie and W. A. Beckman, Wiley.
3. Solar Energy Engineering – Process and Systems, Soteris A Kalogirou, Academic Press.
4. Photovoltaic Systems Engineering, Roger A. Messenger and Jerry Venture, CRC Press.
5. Solar Photovoltaic: Fundamentals, Technologies and Applications, Chetan Singh Solanki, PHI learning Pvt. Ltd.

Course Outcomes:

Sr. No.	**CO statement**	**Marks % weightage**
CO-1	To make use of the concept of solar radiation and principle of measuring instruments.	13
CO-2	To analyze various types of non-concentrating collectors.	24
CO-3	To analyze various types of concentrating collectors.	15
CO-4	To identify various applications of solar thermal energy.	11
CO-5	To explain the various types, materials of solar PV cell and generation development concept.	15
CO-6	To explain the components of PV system.	22

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List of Experiments:

1. To measure the solar radiation using various solar radiation measuring instruments.
2. To evaluate the performance of solar water heater.
3. To evaluate the performance of solar air heater.
4. To evaluate the performance of concentrating collectors.
5. To evaluate the performance of solar still.
6. To evaluate the performance of solar air-dryer.
7. To study and performance evaluation of box type solar cooker.
8. Estimating the effect of Sun tracking on energy generation by solar PV modules.
9. Efficiency measurement of standalone solar PV system.
10. Dark and Illuminated Current- Voltage characteristics of solar Cell.
11. Dependence of Solar cell I- V characteristics on light intensity and temperature.

Major Equipment:

Pyranometer with shading ring, Pyrheliometer, Sunshine recorder, Solar water heater, Solar air heater, Cylindrical Parabolic Collector, Compound Parabolic Collector, Box type solar cooker, Solar drier, Solar still, Solar simulator, PV Module characterization kit, Series and parallel connection of PV module, Standalone solar PV System

Open-source Software/learning website:

1. http://ocw.mit.edu/courses/energy-courses/
2. https://nptel.ac.in/courses/112105051/
3. https://nptel.ac.in/courses/121106014/18
4. https://nptel.ac.in/courses/117108141/
5. http://www.ese.iitb.ac.in/~chetan/PVmaterial.html
6. https://nptel.ac.in/courses/108105058/17