



SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology
Bachelor of Technology



Mechanical Engineering Department
B. Tech. Semester VI

Course Name: Solar Energy Systems **Course Code: BTME19623**
Type of course: Honors - Energy Systems
Prerequisite: Fundamental knowledge of fluid mechanics and heat transfer.
Rationale of Course: The students will be able to understand basic concepts of evolving solar energy systems. They will be able to think of new solutions which provide alternatives for conventional fuel consumption.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	150
4	0	2	5	60	25	15	30	20	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Basics of Solar Energy: Solar radiation outside the earth's atmosphere and at the earth's surface, Instruments for measuring solar radiation and sunshine, energy available from the sun, spectral distribution, solar radiation geometry, empirical equations for prediction of availability of solar radiation on horizontal and tilted surface.	10	17%
2.	Performance of 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	14	23%



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Sr. No.	Topics	Teaching Hrs.	Module Weightage
	plate collector and solar air-heater, testing procedure for solar flat plate collector and solar air heater, effect of various parameters on the performance of collector.		
3.	Performance of Solar Concentrating Collectors: Collector thermal efficiency, collector energy losses, collector incident angle modifier, concentrating collector acceptance angle, collector time constant, dynamic system test method, collector test results and preliminary collector selection, quality test methods, analysis of concentric tube collector.	14	23%
4.	Solar Energy Applications: Construction and working of paraboloid dish collector, central receiver collector, solar energy thermal storage, solar pond, solar cooker, solar still, solar drier, heliostat, solar furnace, photovoltaic system for power generation, solar cell modules and arrays.	10	17%
5.	Solar Economic Analysis: Life cycle analysis, time value of money, description of the life cycle analysis method, the P1, P2 method, uncertainties in economic analysis, construction concepts, energy storage -sensible, latent heat and thermo-chemical storage - pebble bed etc. Materials for phase change - glauber’s salt - organic compounds, solar ponds.	12	20%

Percentage Distribution of Marks as per Bloom’s Taxonomy (Theory/Practical):

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	15	20	25	15	15

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create
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 from above table.



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Reference Books:

Sr. No.	Title of book /article	Author(s)	Publisher	Publication year	Publication edition
1.	Solar Energy: Principles of Thermal Collection and Storage	S. P. Sukhatme and J. K. Nayak	McGraw Hill Publishing Company Ltd.	2016	4 th
2.	Solar Engineering of Thermal Processes, Photovoltaics and Wind	John A. Duffie, William A. Beckman	John Wiley, New York	2020	5 th
3.	Principles of Solar Engineering	D. Y. Goswami, F. Kreith and J. F. Kreider	CRC Press, Taylor and Francis.	2014	3 rd
4.	Solar Energy: Fundamentals and Applications	H. P. Garg and Jai Prakash	McGraw Hill Publishing Company Ltd.	2017	2 nd
5.	Engineering Thermodynamics of Thermal Radiation for Solar Power Utilization	R. Petela	McGraw Hill Publishing Company Ltd.	2010	1 st

Course Outcomes (CO's):

CO. No.	CO Statements After learning this subject, students will be able to	Marks % weightage
CO-1	Identify and recognize the various renewable energy specifically solar energy.	15
CO-2	Analyze and design the performance of various solar concentrating collectors.	20
CO-3	Analyze and design the performance of various solar non-concentrating collectors.	20
CO-4	Illustrate solar systems for various applications.	25
CO-5	Estimate the life cycle analysis method and uncertainties in solar economic analysis.	20



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Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	3	3	1	0	1	3	2	0	1	0	2	1	2	1	1
CO-2	3	2	3	2	2	2	1	0	1	0	2	1	3	2	2
CO-3	3	2	3	2	2	2	1	0	1	0	2	1	3	2	2
CO-4	1	0	2	1	0	1	1	0	0	1	2	2	2	1	1
CO-5	2	1	1	0	1	0	1	0	2	0	0	1	2	1	2
Rationale*	12	8	10	5	6	8	6	0	5	1	6	6	12	7	8

Rationale - Mapping of CO's with PO's and CO's with PSO's:

It states that the course will develop engineering knowledge, addresses societal, health and environmental issue with the aid of knowledge of solar energy.

This course highly maps with Program outcomes 1, 2, 3,6,11 and Program Specific Outcomes 1. It states that the course will develop engineering knowledge, problem analysis, design / development of solutions, the engineer and society, project management and finance and finally it will lead to, convert conceptual knowledge of mechanical engineering to real life application.

List of Practical:

1. To study and measure the solar radiation on horizontal and tilted surface using solar radiation measuring instruments.
2. To evaluate the performance of solar liquid flat plate collector.
3. To study the performance of solar air heater.
4. To study the performance of concentrating collectors.
5. To evaluate the performance of solar still.
6. To evaluate the performance of box type solar cooker.

Major Equipment:

1. Solar power meter
2. Solar liquid flat plate collector
3. Box type solar cooker
4. Solar still

List of open learning website: <https://nptel.ac.in/courses/115103123>