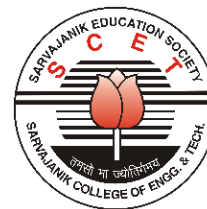




SARVAJANIK UNIVERSITY
Sarvajani College of Engineering and Technology
Bachelor of Technology



Mechanical Engineering
Semester IV

Course Name: Thermal Storage System **Course Code: BTME19423**
Type of course: Honors- Energy Systems
Prerequisite: Engineering Thermodynamics, Heat Transfer
Rationale of Course: The course is designed to acquire the knowledge of sensible and latent heat energy storage systems. The application and necessities of employing thermal energy storage systems in industries is widespread and demands sufficient technical knowledge about the subject for aspirants aiming for energy related careers.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	00	00	

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

Course Contents:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Introduction: Energy demand, energy storage basics, basic principle of thermal energy storage, TES methods, energy storage systems and application, environmental impact.	5	15%
2.	Sensible Thermal Energy Storage System: Principles of sensible heat storage systems, sensible TES using water and rock bed storage system, use of aquifers for storage, pressurized water storage system for power plant applications, use of TRNSYS for analysis and modeling of energy storage systems.	10	25%
3.	Regenerators: Parallel flow and Counter flow Regenerators, Finite Conductivity model, Non-linear model, Transient performance, step changes in inlet gas temperature. Step changes in gas flow rate, Parameterization of transient response, Heat Storage exchangers.	10	20%
4.	Latent Heat Storage Systems: Operational aspects of latent TES, thermal energy storage using ice and snow, principles of solid liquid phase change materials, design of latent heat energy storage system using phase change materials.	10	25%



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Sr. No.	Topics	Teaching Hrs.	Module Weightage
5.	Thermal Storage Applications: Specific areas of application of energy storage food preservation, waste heat recovery, solar energy storage, green house heating, power plant applications, drying and heating for process industries.	10	15%

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	25	20	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 slightly from above table.

Reference Books:

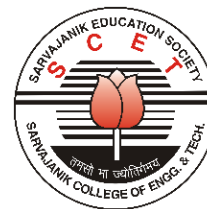
Sr. no.	Title of book /article	Author(s)	Publisher	Publication year	Publication edition
1.	Thermal storage and regenerator	Schmidt, F.W. and Willmott, AJ.	Hemisphere Publishing Corporation	1981	NA
2.	Heat transfer in cold climates	Lunardini, V.J.	D.VanNost and, Reinhold	1981	NA
3.	Thermal Energy Storage: Systems and Applications	Ibrahim Dincer, Mark A. Rosen	Wiley	2021	3rd
4.	Advances in Thermal Energy Storage Systems: Methods and Applications	Luisa F. Cabeza	Woodhead publishing	2020	2nd
5.	Solar Energy: Principles of thermal collection and storage	S. P. Sukhatme, J K Nayak	Tata McGraw-Hil	2017	4th

Course Outcomes (CO’s):

CO No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	To analyze the characteristics of energy from various sources and need for storage.	15
CO-2	Describe sensible heat energy storage and modeling of simple sensible energy storage systems	25
CO-3	To study finite conductivity and non-linear models of regenerators.	20
CO-4	Analyze different phase change material based energy storage systems.	25



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CO-5	To explore various thermal storage systems and its applications.	15
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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	PSO 4
CO -1	3	2	2	1	0	0	1	0	0	0	0	0	2	1	0	0
CO -2	1	1	2	1	2	0	0	0	0	0	0	2	1	2	1	1
CO -3	2	1	2	1	0	0	0	0	0	0	0	0	2	2	1	0
CO -4	3	1	0	0	0	0	0	0	0	0	0	0	2	1	0	0
CO -5	1	2	1	1	0	1	0	0	0	0	0	1	1	0	0	0

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

As per CO's, PO's-PSO's mapping, this course highly maps with PO 1, 2, 3 and PSO 1, 2. It states that the course will identify, formulate, review research literature, and analyze complex engineering problems in energy filed reaching substantiated conclusions using sound knowledge of engineering science and design solution as per engineering problems.

List of Open learning websites:

https://onlinecourses.nptel.ac.in/noc21_ch11/preview