Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2020-2021

Course Handout Part II

16/01/2021

In addition to part I (general handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course no	:	**ME F433**
Course title	:	**Solar Thermal Process Engineering**
Instructor in charge	:	MORAPAKALA SRINIVAS

1. Course Description

Fundamentals of solar energy, earth-sun angles, solar spectrum, solar radiation, measurement and estimation of solar energy on horizontal and tilted surface, conversion routes and technologies, Standards and Performance Testing, thermal utilization of solar energy, modes of heat transfer and equations for performance calculations of systems- conduction, convection and radiation of heat, Flat plate collectors, solar concentrator systems, geometric optics, tracking methods, thermal analysis, energy storage, materials and properties, solar process loads and system calculations for time dependent loads, Life cycle cost analysis and economic analysis for various applications of solar thermal processes, solar water heating, space heating and cooling in Buildings, Industrial process heating, solar air-conditioning and refrigeration, Use of Simulation tools for performance simulation and Project Assignments, solar thermal power generation, Role of Govt., policies and plans.

2. Scope and objective

The main objective the course is to give the student a comprehensive knowledge on design, analysis of solar thermal technologies used for various low temperature as well as high temperature applications. Hands on experience on designing and analysis of these systems would be imparted with the associated software and laboratory based exercises.

3. Text books

1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", First edition, Academic Press (an Imprint of Elsevier), USA, 2009
2. Garg.H.P., Prakash. J, "Solar Energy fundamentals and Applications" Twelfth reprint, Tata McGrawhill, New Delhi, 2010.

4. Reference books

1. John Twidell, Anthony D. Weir, Renewable Energy Resources, 2nd Ed, Taylor & Francis, NY,2006
2. Aldo V. Da Rosa, "Fundamentals of Renewable Energy Processes", Second Edition, Academic Press (an Imprint of Elsevier), MA, USA, 2009.

5. Course plan

Lecture	Learning objective	Topics to be covered	Chapter in the Text Book
1-2	General introduction to renewable energy technologies	Overview of various renewable energy technologies, importance and historical development of Solar energy applications	1 of TB1
3-5	To understand the environmental characteristics associated with solar energy utilization	Sun- earth relationships, Solar angles, calculations of solar energy available at a particular location, on a particular surface,	2 of TB1, 1 of TB2
6-8	Solar radiation and its measurement	Thermal radiation and associated calculations, solar energy measuring techniques	2 of TB1, 1 of TB2
9-11	Comprehensive	Engineering and technological considerations of flat	3 of TB1, 2&3 of TB2

Lecture	Learning objective	Topics to be covered	Chapter in the Text Book
	understanding on Solar energy collectors	plate collectors, dish collectors, trough collectors, etc. and associate thermal analyses	
12-14	Comprehensive understanding on Solar energy collectors	Engineering and technological considerations of dish collectors, trough collectors, etc. and associate thermal analyses	3 of TB1, 2&3 of TB2
15-17	Performance of collectors	Characteristics of various collectors, Critical factors affecting the performance of various collectors, Different kinds of tests to assess the performance of collector	4 of TB1, 2 &3 of TB2
18-20	Solar water heating systems	Engineering and technological considerations of Analysis and design of different kinds of SHWS; Storage systems used for SHWS applications	5 of TB1, 4 of TB2
21-23	Solar water heating systems	Engineering and technological considerations of Storage systems used for SHWS applications	5 of TB1, 4 of TB2
24-25	Solar space heating and cooling systems	Thermal load estimations, passive space heating design	6 of TB1, 10 of TB2
26-28	Solar space heating and cooling systems	Engineering and technological considerations of Analysis and design various Solar space heating and cooling systems, heat pumping systems	6 of TB1, 10 of TB2
29-30	Desalination systems	Importance and relationship between water and energy, Desalination of water.	8 of TB1, 6 of TB2
31-33	Solar desalination systems	Desalination processes, thermal analyses, performance of solar stills	8 of TB1, 6 of TB2
34-38	Designing and Modeling Solar Energy Systems	f-chart method and Designing of systems using f-chart method and program	11 of TB1
39-42	Solar Economic Analysis	Life cycle analysis, Time value of money, Description of the life cycle analysis method, etc.	12 of TB1, 18 of TB2

6. Evaluation scheme

Evaluation component	Duration	Weightage	Date/Time/Venue	Evaluation type
Mid semester test	90 min	30%	06/03 9.00 - 10.30AM	Open book
Class test[#]	40 min	15%	To be announced	Open book
Lab/simulations based projects/Written assignments[@]	Take home	15%	To be announced	Open book
Comprehensive Examination	2 hours	40%	17/05 FN	Open book

#No of class test is one. Other details would be communicated separately

@ No of assignments is one, the topic of which would be given to the students. The reports are to be submitted in hand written format. Other details would be communicated separately The projects are based on laboratory investigations and/or simulations using TRNSYS/other solar energy/energy software. For each of the projects, a report is to be submitted. All other details would be communicated separately.

7. Chamber consultation hours To be announced in class.

8. Course notices To be displayed on ME notice board only.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge, ME F433