Solar Thermal Energy

1.1 Course Number: CH351
1.2 Contact Hours: 3-0-0 Credits: 9
1.3 Semester-offered: 3rd Year-Even
1.4 Prerequisite: Basic concepts Heat Transfer

2. Objective: The objective of course for students is to acquaint with the use of solar energy in current renewable energy scenario and to learn the various techniques of solar thermal engineering and its application in energy domain

3. Course Content:

Unit wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction to Solar physics	Energy dependence on external sources and sun, Physical descriptions and reactions, Solar physics and geometry of earth, Terrestrial radiation, Measuring instruments, Estimation of solar radiation, Radiation Processing - Evaluation of the apparent sunrise and sunset angles, Estimation of daily/monthly average daily tilt factor under terrestrial conditions.	7
2	Solar Radiation	Instantaneous direct and global radiation received on a surface, Calculation of direct energy received on a surface, Solar collector basics, Transmission - Absorptance Product.	4
3	Electromagnetic Spectrum and Different Terms	The electromagnetic spectrum, Photon radiation, The Blackbody: perfect absorber and Emitter, Planck's law and Wien's displacement law.	4
4	Radiation Characteristics of Opaque Materials	Absorptance and Emittance, Kirchhoff's law, Reflectance of surfaces, Relationships among absorptance, Emittance and Reflectance, Broadband emittance, Calculation of emittance and absorptance, measurement of surface radiation properties.	7
5	Theory of Collectors	Theory of flat plate collectors, Mean temperature and heat capacity effects, Theory of air based solar flat plate collectors, Other collector geometries, Concentrating collectors.	5
6	Energy Storage	Process loads and Solar collector outputs, Energy storage in solar process systems, Stratification in storage tanks	5

7	Solar Process Economics	Costs of solar process systems, Life-cycle savings method, Evaluation of other economic indicators, The *P*1, *P*2 method	5
8	Building Heating	Passive and Hybrid methods	3
		Total	**40**

4. Readings

4.1 Text Books:

1. Solar Engineering of Thermal Processes by J. A. Duffie and W. A. Beckman.
2. Solar Thermal and Biomass Energy by G. Lorenzini, C. Biserni, G. Flacco.

4.2 Reference Books:

1. Solar Thermal Energy and the Collection and Storage of the Sun's Power by S.B. Jeffrey.

5. Outcome of the Course: The need for alternate energy sources, potential of solar and wind options, advantages, and lacunae of solar energy as an alternative energy source will be the major highlight of the course. The students will understand the concepts of energy quality and energy services in engineering context and the potential impact of solar thermal systems. After completion of the course students will be able to comprehend the solar resource and use this knowledge for design of solar thermal systems and balance theoretical and practical aspects of solar thermal design. The course will also help students to analyze simple solar thermal systems through software modelling and understand the limitations of such models.