Course Code ESE-811	Credit Hours (Th-Pr) 3.0-0	**Solar Thermal Energy (Elective)**	Contact Hrs/Week (Th-Pr) 3.0-0	Total Contact Hrs (Th-Pr) 45-0

Course Outline:

Sun earth relationships, solar radiation and its measurement, solar radiation climatology; thermal processes in solar and flat-plate collectors; concentrating collectors; applications of solar thermal energy; solar cooling applications; Solar drying; Heat storage, storage media, steam accumulator, other storage systems, heat exchangers and applications of stored energy. Types of solar energy concentrators, Fresnel lenses and Fresnel reflectors, operating solar cells at high incident energy for maximum power output. Solar thermal technologies for buildings.

Eligibility Criteria:

B.E in Mech., Elect (Power), Chemical, Industrial, Process

B.S (4-years) Or M.Sc. degrees in Physics

Recommended Books:

S. No.	Title	Author(s)	Assigned Code	Remarks
1.	Solar Engineering of Thermal Processes,	J. A. Duffie, and W. A. Beckman	DB	Text
2.	Principles of Solar Engineering	Y. Goswami, F. Kreith and J. F. Kreider	GKK	Reference
3.	Solar Energy Engineering: Processes and Systems	Soteris A. Kalogirou.	SK	Reference
4.	Concentrated Solar Thermal Energy	Christopher Newton	CN	Reference
5	Applied Photovoltaics	S. R. Wenham, M. A. Green and M. E. Wat	WG	Text
6	Solar Cells: Operating Principles, Technology and System Applications	M. A. Green	GM	Reference

7	Solar Electricity: Engineering of Photovoltaic Systems	E. Lorenzo, G. Araujo, A. Cuevas	LAC	Reference

Course Objectives:

This course is aimed at providing the students with an understanding of the processes in the established solar energy technology. Specifically, this course will deal with the solar radiation estimation techniques, the principles of operation, performance analysis and application of solar thermal conversion devices. Current and future applications of solar thermal and thermal energy storage are covered.

Learning outcome:

The course provides an integrated approach towards both solar/PV & Solar thermal system utilization. It advances the understanding of energy conversion processes from device to utility platforms. The systems covered offer the possibility of stand-alone use as well as in conjunction with conventional energy resources. The latter strategy will enable to supplement or relieve the load on fossil fuels.

Topics Covered:

No.	Topics	Text Book	Contact Hours
1.	**Solar Radiation** • Sun Earth Relationships and Apparent Position of the Sun Extraterrestrial Radiation and Attenuation of Radiation • Estimation of Terrestrial Solar Radiation; Time Scales; Orientation. • Radiation transmission through opaque materials and glazing • Selected Heat transfer topics related to solar thermal energy	DB	7
2.	**Solar Thermal Energy Conversion** • Heat Transfer Processes in Flat-plate Solar Collector • Efficiency of Flat-plate Solar Collectors.	GKK DB	7

	• Solar Collector Performance Models, Collector Efficiency Factor, Heat Removal Factor. • Concentrating Collectors: Types, Performance and Efficiency • Solar air collectors and their applications • Solar Process loads • Solar Process economics		
3.	**Applications of Solar Thermal Energy** • Uses of Low and Medium Temperature Solar Thermal Energy: Water Heating and Air Heating Systems, Distillation and Cooling • High Temperature Solar Thermal Energy for Heat and Electricity • Recent Advances in Solar Thermal Applications in Industry and Buildings	DB ,CN & SK	7
4.	**Solar thermal Cooling for building application** • Open cycle solar desiccant cooling • Closed cycle solar adsorption cooling systems • Solar absorption cooling systems • Solar assisted vapour compressing cooling • Thermal analysis of building integrated solar components **Passive solar energy and it usages**	DB GKK & GM & LAC	8
5.	Solar industrial process heat Solar Ponds: Evaporative processes Simulations in solar thermal energy process Design of Active systems: f chart method Design of Active systems: utilization method	DB LAC	10
6.	**Thermal Energy Storage for Solar application** • Thermal Storage Systems for Liquid and Air Systems Water storage and stratification in storage tanks • Packed bed storage • Seasonal storage • Phase change material storage techniques	DB & LAC	6

	• Chemical energy storage		