III Year II Semester | **L T P C**
17EE631 | **3 1 0 3**

PROFESSIONAL ELECTIVE-I
SOLAR ENERGY AND ITS APPLICATIONS

Preamble:
The aim of this course is to allow the students to recognize the basic physics about solar engineering, origin and related devices used to collect solar energy and to expose the students with the different aspects of measurement, harvesting and utilization of solar energy.

Learning Objectives:
- To Study the concept of various laws related to solar engineering
- To analyse the Design of solar thermal collections.
- To understand the Design of solar photo voltaic systems and to deal with grid connected PV systems
- To discuss about different energy storage systems and Use of renewable source for energy conversion
- To understand the design of solar photo voltaic systems and Develop maximum power point techniques in solar PV
- To Understand the **Economic Analysis** Solar Energy Systems

UNIT–I:
Fundamentals of Solar Energy Systems
Basics of solar energy-Brief History of solar energy utilization- Sun as the source of radiation- Solar radiation- Measurement of solar radiation-Irradiance- Solar constant- Insolation- Radiosity- Emissive power- Earths equator- Meridian Longitude- Sun earth angles- Sunrise, sun set and day length- Solar time- Equation of time Various Methods of using solar energy- Photo thermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

UNIT – II
Solar Cells
Various generations- Semiconductor materials- Doping- Fermi level- PN junction and characteristics- Photovoltaic effect- Photovoltaic material- Parameters of solar cells- Effects of cell temperature on cell efficiency- Types of solar cells- Solar modules and arrays- Advantages and limitations of solar energy system- Solar cell power plant- Silicon, thin film and polymer processing- Silicon wafer based solar cells.

UNIT – III
Solar Thermal Energy
Stationary collectors- FPC- CPC- ETC- Sun tracking concentrating collectors- PTC- PDR- HFCFresnel collectors- Solar thermal power plants- Solar chimney power plant- Solar pond- Solar water heater- Solar cooker- Types- SODIS- Thermal energy storage- Solar cooling- Limitations of solar thermal energy.

UNIT – IV
Solar Photovoltaic's
Photovoltaic cell function– IV characteristics – System design**:** storage sizing – PV system sizing – Maximum power point techniques**:** Perturb and observe (P&O) technique – Hill climbing technique. Applications of PV system- SPV lighting system- Solar water pumping system- Solar vehicles- Solar dryer- BIPV- Features of SPV system

Unit – V

Energy Storage

Necessity of storage for solar energy-Chemical energy storage-Thermal energy storage-Thermal Flywheels-Compressed air-Rechargeable batteries.

Unit – VI

Economic Analysis

Life cycle analysis of Solar Energy Systems – Time Value of Money – Evaluation of Carbon Credit of Solar Energy Systems.

Course Outcomes:

- Students are able understand the concept of various laws related to solar engineering
- The students completing the course will have the ability to assess solar energy potential
- Students are able to identify and describe different direct and indirect solar energy tapping systems including Solar Photovoltaic's, solar cells and solar thermal power plants
- Students are able to discuss about different energy storage systems and Use of renewable source for energy conversion
- Students are able to Design solar photo voltaic systems and Develop maximum power point techniques in solar PV
- Students are able to Understand the **Economic Analysis** Solar Energy Systems

Text Books:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Tiwari G.N, "Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
3. Solar Photovoltaics: Fundamentals, Technologies And Applications by Chetan Singh solanki 3rd Edition, Kindle Edition

References:

1. Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, NewYork, Jui Sheng Hsieh, Solar Energy Engineering,Prentice-Hall, 2007.
2. .M. Stix, The Sun, An Introduction, Second Edition, Springer 2002.
3. Nelson, The Physics of Solar Cells. Imperial College Press, 2003.
4. Rai,G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.
5. Sukhatme S.P., Solar Energy, Tata McGraw Hills P Co., 3rdEdition, 2008.