Approval: 5th Senate Meeting

Course Name : Solar Photovoltaic Energy Systems
Course Number : EE-506
Credit : 2.5-0.5-0-3
Prerequisites : EE309 Power Electronics (or Instructor's permission)
Students intended for : B.Tech./M.S./Ph.D
Elective or Compulsory : Elective
Semester : Odd/Even

Course Preamble: Large scale shift to renewable energy resources from fossil fuels is needed in order to limit and reduce the greenhouse gases released by the human use of fossil fuels. Among the renewable energy options available, solar energy represents a promising and major energy resource. This course focuses on solar photovoltaic (PV) energy systems, which convert solar energy into a convenient electrical energy form. We will mainly study the types of electrical components and schemes used in such PV systems. The course will cover the characteristics of solar radiation, PV cells, modules and arrays, stand-alone PV schemes with battery energy storage and grid-connected PV schemes.

Course Syllabus:

Introduction (3 hrs)

Fossil fuel energy usage and global warming; role of renewable energy in sustainable development; renewable energy sources; global potential for solar electrical energy systems.

Solar radiation (9 hrs)

Extra terrestrial and terrestrial solar spectrum; clear sky direct-beam radiation; total clear sky insulation on a collecting surface; radiation on the collector in tracking systems; calculation of average monthly insolation from measured data.

PV cells and modules (6 hrs)

Photovoltaic cell and its simple model; i-v and p-v characteristics; PV modules and arrays; effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; schemes for maximum power point tracking; solar PV concentrators.

PV inverters (9 hrs)

Grid-connected single phase PV inverter schemes and control; power processing schemes based on single string, multi-string and ac module technologies; types of grid interface; power electronic converters used in single phase PV systems and their operation; transformer less inverters, centralized grid-connected three-phase inverters for large PV installations.

Schemes with battery energy storage (9 hrs)

Power processing schemes and control for stand-alone applications; batteries for energy storage – types, charging, battery sizing and turn-around efficiency; other types of energy storage for PV systems; grid connected schemes with standby energy storage.

System level issues (6 hrs)

Design related issues; grounding, dc arcing and other safety related issues; islanding; harmonics; electro-magnetic interference; energy yield and economics of a PV installation.

Text Book:

1. Gilbert M. Masters: Renewable and Efficient Electric Power Systems. John Wiley & Sons, 2004

Reference Books:

1. Roger A. Messenger & Jerry Ventre: Photovoltaic Systems Engineering. CRC Press, 2004, 2nd ed.
2. Solanki: Solar Photovoltaics: Fundamentals, Technologies and Applications. PHI Learning Pvt Ltd, 2009