SOLAR PHOTOVOLTAICS FUNDAMENTALS, TECHNOLOGY AND APPLICATIONS

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PREREQUISITES: Basic knowledge of 12th standard physics is sufficient
INDUSTRIES APPLICABLE TO : Renewable energy sectors, Power industries and Green building companies will be interested

COURSE OUTLINE :

The most important scientific and technical challenges facing humanity in the 21st century are Energy security, Environmental security and Economic security and these can likely be met only through addressing the energy problem with in the next 10–20 years. Meeting global energy demand in a sustainable fashion will require not only increased energy efficiency and new methods of using existing carbon based fuels but also renewable energy. Moreover, rising prices and sporadic shortages of fossil fuels provides the impetus for the present worldwide effort to develop alternative sources of energy. Solar energy is to be a major primary energy source and utilization requires solar capture and conversion. In this course we will discuss about various photovoltaics technologies, different generation of solar cells, device fabrication and characterization techniques and applications in industries.

ABOUT INSTRUCTOR :

Prof. Soumitra Satapathi is an Assistant Professor in the Department of Physics at Indian Institute of Technology, Roorkee and also the visiting Professor of Physics at University of Massachusetts Lowell, USA. He is also a joint faculty in the Center for Nanotechnology at IIT Roorkee. Before joining to IIT Roorkee, Prof.Satapathi was a postdoctoral research fellow at Tufts University Boston, USA. He received his M.S and Ph.D. degree in Physics from University of Massachusetts Lowell, USA in 2010 and 2012 respectively. He has published more than 20 international journal papers and received several international awards including Marquis Who's Who of America 2011and BASE Award on Solar Photovoltaic from DST. His research is focused on the development of advanced materials and their use in organic electronics including organic solar cells, LEDs and sensors.

COURSE PLAN :

Week 1: Introduction to course, Review of Semiconductor Physics, Charge carrier generation and recombination, p-n junction model and depletion capacitance, Current voltage characteristics in dark and light

Week 2: Device Physics of Solar Cells, Principle of solar energy conversion, Conversion efficiency, Single, tandem multi-junction solar cells, Numerical solar cell modeling

Week 3: Numerical solar cell modeling, Crystalline silicon and III-V solar cells, Thin film solar cells: Amorphous silicon, Quantum Dot solar cells,

Week 4: Introduction to Dye Sensitized Solar Cells, Fabrication of Dye Sensitized Solar Cells, Design of novel dyes, Design of solid electrolytes materials, Counter electrode engineering

Week 5: Introduction to Organic Solar Cells, Physics of Bulk Heterojunction(BHJ) Solar Cells, Morphology and charge separation in BHJ, Design of low bandgap polymers

Week 6: Perovskite Solar Cells, Fabrication of perovskite solar cells, Photophysics in perovskite solar cells, Stability in perovskite solar cells, Lead free perovskite solar cells

Week 7: Photovoltaic system engineering, Thermo- Photovoltaic generation of electricity, Concentration and storage of electrical energy, Photovoltaics modules, system and application, Green energy building

Week 8: Nanomaterials for photovoltaics, PV panels with nanostructures, Band gap engineering and optical engineering, Photo thermal cells, Energy Economy and management