



Six days course on

Next Generation Solar Cells in the realm of Future Energy Challenges: From Materials Design to Device Architecture

11th-16th December 2017

For practicing engineers, scientists & aspiring researchers



**Discipline of Electrical Engineering,
Indian Institute of Technology Indore,
Simrol, Khandwa Road, Indore, Madhya
Pradesh, 453-552.**

<http://iiti.ac.in/GIAN>

Course Overview:

Increasing world population coupled with the demand for improved standards of life have contemplated surge in demand for energy, with more than 80% of which presently is tapped from fast depleting non-renewable resources. To solve the challenge of energy crisis various approaches are being considered at present. One such approach is to harness solar energy into electricity by means of solar cells. However, a major deterrent in the commercialization of the existing solar cell technology is the cost of production and thereby the payback time. In this regard amongst the next generation solar cells, the nanoporous dye sensitized solar cells (DSSCs) offer a new ray of hope, mainly owing to their low cost of production, light weight and flexibility (particularly of solid state DSSCs). To gain better insight into the working of a DSSC one needs to understand underlying physics, chemistry, nanoelectronics and materials science. This course aims to take the participants through the various aspects of materials design and device architecture of DSSCs. Some other underlying concepts related to DSSCs viz. circuit modeling and electrochemical impedance spectroscopy will also be discussed in detail.

This is a single module course having one credit in all. The topics of the module will expose the participants to the entire gamut of DSSC based PV technology, viz. nanoporous oxide layers, functional dye molecules, the electrolyte media and the Platinum based counter electrodes and its alternative substitutes.

Course contents:

1. Overview of renewable and non-renewable sources of energy
2. Introduction of solar cells
3. Next generation solar cells
4. Dye-sensitized solar cells
5. Conducting polymer based organic thin film solar cells
6. Organic-inorganic hybrid perovskite solar cells
7. Semi-transparent next generation solar cells (scope & importance)
8. Challenges in the commercialization of DSSCs
9. Future directions

The course contains 12 hours of lectures and 4 hours of tutorials. A quiz will also be conducted at the end of this course for evaluation purpose. Participation certificates will be given to all participants.

Who can attend?

- Executives, engineers and researchers from industry, service and/or government organizations, R & D laboratories of national repute.
- B.E./B. Tech., M.Sc. / M. Tech. and Ph.D. students of any institute, and faculty from reputed academic and technical institutions, willing to work on problems related to design and manufacturing of next generation photovoltaic cells.
- B.E./ B. Tech., M.Sc./M. Tech. qualified teachers for upgrading their knowledge in the important and multidisciplinary field of photovoltaics.



Teaching Faculty:
Prof. Shyam Sudhir Pandey was born in the Kushinagar district of Uttar Pradesh, India on January 1st, 1967. After completing his Ph. D. From, National Physical Laboratory, New Delhi, India in 1997 in the area of organic conducting polymers, he went to Japan as post-doctoral fellow in 1998. He worked as Fukuoka IST sponsored post-doctoral fellow in the Kyushu Institute of Technology from 1998-2001 in the area of photo-functional materials and devices. He was JSPS post-doctoral fellow from 2001-2003 (Soft-actuators & Artificial Muscles) and Knowledge Cluster invited researcher from 2003-2007 (Protein Biochips). He worked in Kyushu Institute of Technology as Assistant Professor from 2009-2012. Currently he is an Associate Professor at the Graduate School of Life Science and Systems Engineering, Kyushu Institute of Technology since 2012. He has received National Technology Award from National Research Development Corporation, Government of India in 2005 for the development of Glucose Biosensors, which is currently being manufactured and marketed also. He has published more than 170 papers in international refereed journals and has over 25 patents in India, Japan, Europe and USA to his credit. His research interests deal with the Dye-Sensitized and Organic Solar Cells, Quantum Chemical Calculations, Organic Electronics & Optoelectronics, Organic Conducting Polymers, Biosensors and Protein Biochips.

Course co-ordinator:



Dr. Vipul Singh is presently working as an Associate Professor in the Discipline of Electrical Engineering at Indian Institute of Technology Indore. He obtained his Ph.D. degree from Department of Biological Functions and Engineering, Graduate school of LSSE, Kyushu Institute of Technology, Wakamatsu, Fukuoka, Japan. His research interests are in the areas of Silicon nanodevices, Organic electronics, ZnO nanostructures, charge carrier transport in organic materials, Conducting Polymers, Biosensors, Photosensitive transistors, LEDs and Solar cells.

Registration Fees:

Students (UG/PG) : Rs. 4,000/-
Research scholars : Rs. 6,000/-
Faculty Members: Rs. 10,000/-
Foreginers: USD 300
Industry and Others: Rs. 15,000/-

Important Dates:

Last date for registration:
December 09, 2017.
Course duration: 11th – 16th
December, 2017.

Links for registration:

<http://gian.iiti.ac.in/register.php>
<http://www.gian.iitkgp.ac.in/>

Accommodation:

Paid accommodation will be provided to the participants on a first come first serve basis. Course fees includes course material, tutorial sheets, lecture handouts, lunch and tea during course days.

Contact Details:

For more detailed information please contact course co-ordinator;
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Homepage: <http://iiti.ac.in/people/~vipul/index.html>

Details about the lectures

Day/ Date	Lecture 1	Lecture 2	Tutorial
11/12/17 (Mon)	Introduction and overview of the course, energy demand and supply, renewable versus non-renewable sources of energy, solar energy prospects and challenges.	Introduction of solar cell technology, Fundamental aspects and working principle, current status of power conversion efficiency, challenges with the presently available solar cells.	
12/12/17 (Tues)	Overview of Next Generation Solar Cells viz. DSSCs, OSCs and hybrid Perovskite solar cells.	DSSC part 1: in depth discussion on device configuration, fabrication and working principle.	Tutorial on Fabrication of DSSCs.
13/12/17 (Wed)	DSSC part 2: Current status and state of the art devices, factors affecting photoconversion efficiency, Computational Molecular design of functional sensitizers.	DSSC part 3: Approaches towards enhancing the photoconversion efficiency, strategies for controlling dye adsorption and their implications towards photon conversion efficiency.	DFT simulations and how it can provide insight into material designing aspect.
14/12/17 (Thurs)	Conducting polymer based organic solar cells: Journey from past to present.	Organic-inorganic hybrid Perovskite solar cells.	EIS as a tool for studying electrode interface
15/12/17 (Fri)	Semi transparent see-through next generation solar cells, their scope and importance.	Challenges in the commercialization of next generation solar cells, focus on cost and long term stability.	Circuit level simulations
16/12/17 (Sat)	Future directions for next generation solar cells: TCO less DSSCs.	Cylindrical DSSCs, their need and significance.	Quiz