

## New Course Proposal, IIT Mandi (Modified)

Course Name:	Photovoltaic materials and fabrication
Course Number:	EM 651
Credit:	3-0-0-3
Prerequisites:	Device electronics for integrated circuits (EE 311)/ Introductory course on semiconductor devices/ <i>Instructor's consent</i>
Students intended for:	3 <sup>rd</sup> year and 4 <sup>th</sup> year UG, PG
Elective or Core:	Elective for M.Tech
Semester:	Even/ Odd

### Preamble:

The objective of the course is to develop an understanding of the necessary ideas of photovoltaic sciences. The course is broadly divided into three modules, with each separately covering the topics of photovoltaic devices, PV systems and PV technology. On the completion of the course, the students will have a good understanding of the functioning of solar cells, along with requisite knowledge of PV systems and available photovoltaic technologies.

### Course Syllabus

1. **Semiconductor Electronics** [7 lectures]
  - a. Physics of Semiconductor Materials
  - b. Band Model of Solids
  - c. Concept of equilibrium and non-equilibrium in semiconductor device
  - d. Current conduction mechanisms in semiconductors
  - e. Fundamentals of  $p-n$  junction
  - f. Operation of  $p-n$  junction under forward and reverse bias
2. **Basics of Photovoltaics**[7 lectures]
  - a. History of solar cells
  - b. Principle of detailed balance
  - c. Principles of carrier separation and generation-recombination
  - d. Operation of solar cells
  - e. Design of solar cells
3. **Advanced concepts in solar cells**[7 lectures]
  - a. Theory of multi-junctions solar cells with an emphasis on tunnel junctions between them
  - b. Physics of heterojunctions and other junctions such as Schottky diodes and ohmic contacts
  - c. Induced junctions, MIS solar cell and carrier selective contact approaches

**4. Solar resources and PV performance** [4 lectures]

- a. Solar radiation
- b. Calculation of direct and diffuse radiation
- c. Solar modules and arrays
- d. Performance evaluation of PV modules

**5. Reliability of photovoltaic modules** [6 lectures]

- a. Familiarization with IEC certification testing
- b. Microclimate of PV module
- c. Influence of microclimate on reliability of PV module

**6. Components of photovoltaic systems**[4 lectures]

- a. Different PV system topology
- b. Introduction to power electronic components
- c. Grid integration of photovoltaics

**7. PV technology** [7 lectures]

- a. Silicon solar cell fabrication
- b. III-V technology
- c. Thin film technology
- d. Other emerging technologies

**Text Book**

1. Jenny Nelson, "Physics of solar cells", Imperial College Press, 2003
2. Roger Messenger, Jerry Ventre, " Photovoltaic systems engineering", CRC press

**Approvals**

Other Faculty interested in teaching this course: Dr. Satvasheel Powar, Dr. Ankush Bag

Proposed by: Kunal Ghosh

School: SCEE

Signature

Date :

-----  
Recommended/Not Recommended, with Comments: