SEMESTER: S7

POLYMERS & PHOTOVOLTAIC TECHNOLOGY

Course Code	**PEPOT757**	**CIE Marks**	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Prerequisites (if any)	Basic Electrical and Electronics Engineering, Plastic Materials	**Course Type**	Theory

Course Objectives:

1. Students will be able to understand manufacture methods for polymer and organic based photovoltaic cells

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Solar energy, solar neutrinos, radiant power, types of solar cells, organic solar cells, band gap and efficiency, photo generated current density, absorption coefficient, power conversion efficiency, auger and SRH lifetime, multiple junctions, hot carrier cells.	**9**
2	Photo voltaic modules, Modelling, electrical characteristic of PV module, double diode model, single diode model, model parameters, circuit parameters, short circuit current, open circuit voltage, loading conditions, photovoltaic generator current-voltage characteristics, peak power, fill factor.	**9**
3	Materials and processing –substrate, front electrode, first intermediate layer, materials used, processing, active layer, materials and processing, polymer-polymer solar cells, polymer-fullerene solar cells, organic-inorganic hybrid solar cells, p type and n type polymers, second intermediate layer, materials used, processing	**9**

4	Stability and characterisation of devices, stability measurement, manufacture of polymer solar cells, photoactive wide band gap donor, small band gap donor, polymer tandem cells, small molecule tandem cells, semi-transparent tandem solar cells. Solution processed organic photovoltaics, slot-die coating process, inkjet printing process, roll to roll printing process, materials for functional layers, flexible substrates, silver back electrodes, interfacial layer, hole transport layer, electron transport layer, issues in scalable OPVs.	**9**

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

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End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Demonstrate the principles and instrumentation of photovoltaic cells.	**K2**
CO2	Outline the functions of each part of the PV module.	**K2**
CO3	Analyze the modern manufacturing process in OPV cells.	**K4**
CO4	Categorize different materials used for solar cells.	**K4**
CO5	Explain the power generation process of OPV cells	**K5**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**											
CO2	**3**											
CO3	**3**											
CO4	**3**											
CO5	**3**											

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Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Solar Cell Device Physics.	Fonash, Stephen	Elsevier	2012.
2	Thin Film Solar Cells: Fabrication, Characterization And Applications.	Poortmans, Jef, and Vladimir Arkhipov, eds	Vol. 18. John Wiley & Sons	2006.
3	Fuel Cell Technology Handbook.	Hoogers, Gregor, ed	CRC press	2002.
4	Solar cell array design handbook: the principles and technology of photovoltaic energy conversion.	Rauschenbach, Hans S	Springer Science & Business Media	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	"Polymer solar cells." Photo responsive Polymers II	Hoppe, Harald, and N. Serdar Sariciftci.		2007):
2	Stability and degradation of organic and polymer solar cells	Krebs, Frederik C., ed.	John Wiley & Sons,	2012.
3	Molecular devices for solar energy conversion and storage.	Tian, Haining, Gerrit Boschloo and Anders Hagfeldt, eds.	Singapore: Springer	2018
4	Nanostructured materials for solar energy conversion.	Soga, Tetsuo, ed.	Elsevier	2006.
5	Carbon-containing polymer composites	Rahaman, Mostafizur, Dipak Khastgir, and Ali KanakhirAldalbahi, eds	Singapore: Springer,	2019.
6	Polymer photovoltaics: materials, physics, and device engineering.	Huang, Fei, Hin-Lap Yip, and Yong Cao, eds	Royal Society of Chemistry	2015

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1 - 4	Prof Soumitra Satapathi, IIT Roorkee https://www.youtube.com/ watch?v=5zAQot4pKgU&list=PLLy_2iUCG87Dxsmc322YcSuNl_KCEbqPl https://www.youtube.com/watch?v=F2sZgWgvTAg

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