OEPMA Organic Electronics and Optoelectronics : Materials and applications

Semester : **6**
Course : **Open Elective** Credits : **3** Hours : **3**

Course Context and Overview (100 words):

The economic, health and National security rely on and are positively impacted by electronic and optoelectronic technology. However, the resources and methodologies used at present to manufacture these devices raise urgent questions about the negative environmental impacts of their manufactures, use, cost and disposal. The use of organic semiconducting materials to replace the existing materials, offer more eco-friendly and affordable approach to growing our electronic and optoelectronic devices.

In this innovative course, the students will have the basic knowledge for studying the basic fundamental of organic semiconductors, the electronic and photonic process involved in these materials, and as well as the devices based on these materials. The basic of different electronic and optoelectronics devices i.e. organic field effect transistor, memory devices, organic solar cells and dye sensitized solar cells will taught in this innovative course.

Prerequisites Courses:
Nil

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 understand the fundamental of organic semiconductors and how they are different of silicon and germanium
C02 The students will acquire knowledge of different electronic device based on organic semiconductors
C03 The students will be able to compare different building materials and architectures for organic electronics and optoelectronics devices
C04 The students will be able to discuss different types of organic solar cells and their working and applications

Course Topics:

Topics	**Lecture hours**

UNIT - I Fundamentals of organic semiconducting materials Conjugated Organic materials Electrical conductivity, insulators, Semiconductors, conductors, Band theory and molecular orbital theory, Comparison between different bond based materials, Low molecular weight molecules and polymers: advantage and disadvantages, Charge carriers, excitons	8
UNIT –II Organic devices, injection and extraction of charge carriers Charge carrier mobility and charge transport properties of organic semiconductors	5
UNIT – III Field effect transistors based on organic materials: Basics of field effect transistors, output characteristics and transfer characteristics, Configuration of FETs, requirement for organic materials for n-channel and p-channel ambipolar OFETs, role of dielectric and of the molecular organization of the organic layer	6
UNIT – IV Light emitting diodes based on organic materials (OLEDs) Basics of OLEDs, luminance –voltage and efficiency –voltage characteristics, device structures, hole transporting layer, electron transporting layer, emissive layer, formation of emitting states, fluorescent and phosphorescent emitters, requirements of emitting materials, some basics of light emitting transistors	6
Unit V Organic memory devices	2
UNIT – VI Solar cells based on organic materials Basics of solar cells, current –voltage characteristics, definitions of photovoltaic parameters, photogeneration of excitons and formation of free charge carriers in organic materials, Electron donor and electron acceptor materials, single layer, double layer and bulk heterojunction solar cells, requirements of electron donor and acceptor materials and role of morphology of the active layer, different	10

architectures, dye sensitized solar cells, inorganic – organic hybrid solar cells	
UNIT – VII Fabrication method of organic solar cells	2
UNIT – VIII Organic electronics and optoelectronics R & D aspects	1
UNIT – IX cost aspect and current opportunities	1
UNIT –X Demonstration , quizzes, assignments and discussions	2

Textbook references :
Text Book : No specific text book. Study materials provided by instructor.

Reference books :

1. Molecular Electronics: from Principles to practice, John Wiely & Sons Ltd Chichester, 2007
2. Electronic Processes in Organic crystals and polymers, M. Pope & C.E. Swenberg, Oxford University Press 1999
3. Introduction to Organic Electronics Optoelectronic Materials and devices, s. S. Sun, L. R. Dalton, CRS press
4. Organic Electronics: Emerging concepts and Technologies, F. Cicoira & S. Santato, Wiley VCH ISBN – 978-3-727-41131-3
5. Physics of Organic Semiconductors, W. Brutting, Wiley VCH ISBN 978-3-537-60679-5
6. Organic Electronic and Photonic Materials and Devices, ISBN-9781107412279
7. Organic Solar cells: fundamentals, Devices and upscaling, B.P. Rand & H. Richter, CRC Press, 2014

Additional Resources: Research papers supplied by Instructor

Evaluation Methods:

Item	Weightage
Quizzes and Home assignments	15%
Midterm	30%
Final Examination	50%
Attendance	5%

Prepared By: Prof. G. D. Sharma
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