Organic electronic Materials and devices

Programme : **PhD** Year : **--** Semester : **--**
Course : **Program Elective** Credits : **4** Hours : **50**

Course Context and Overview (100 words):

Organic electronic devices are quickly making their way into the commercial world, with innovative thin mobile devices, high-resolution displays, and photovoltaic cells. The future holds even greater potential for this technology, with an entirely new generation of ultralow-cost, lightweight and even flexible electronic devices, which will perform functions traditionally accomplished with much more expensive components based on conventional semiconductor materials, such as silicon. Learn more about this highly promising technology, which is based on small molecules and polymers, and how these materials can be implemented successfully in established (e.g., organic light-emitting devices (OLEDs), organic photovoltaic (OPV) devices, organic-inorganic hybrid, dye sensitized solar cells, organic memories and field effect transistors.

In this course you will gain the understanding of organic semiconductors, charge transport in these materials and design the next generation of organic electronic materials and devices.

Prerequisites Courses:
M.Sc (Physics or Chemistry / M. Tech (Electronics communination)

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1 understand the difference in the organic and inorganic semiconductors, formation of bonding in the organic semiconductors, formation of frontier molecular orbitals, different types of charge transport mechanisms in these materials.
C02 The students will acquire detail knowledge on the working principles of different types of the organic electronics and opto-electronics devices
C03 The students will acquire knowledge on organic solar cells, organic light emitting diodes, field effect transistors and organic memory devices, Materials and device fabrication
C04 The students will acquire knowledge about the dye sensitized solar cells and pervoskite solar cells

Course Topics:

Topics	**Lecture hours (60)**
UNIT - I **Different type of materials, chemical bonding in organic materials, formation of frontier molecular energy levels, tailoring of optical and electrochemical properties of organic semiconductor, band gap engineering of organic semiconductors, optical properties of organic materials, Electronic structure of materials, Difference between small molecules and polymers, experimental method for the determination of energy levels of the organic materials, difference between organic and inorganic semiconductors, Concept of donor and acceptor in organic materials, Donor –acceptor molecules and polymers, classification and**	15

concept of n type and p type organic semiconductors	
UNIT - II **Electron Delocalization in Small Organic Molecules and Polymers, Intramolecular Electron Delocalization in π-Conjugated Systems, Interaction of π-Conjugated Systems with Light, Charge Carrier Generation in Organic Molecules, Charge Transport in Organic Materials, Interplay of Supramolecular Packing, Microstructure, Defects, and Charge Transport**	5
UNIT – III **Materials for organic solar cells, difference between organic and inorganic solar cells, photo charge carrier generation mechanism in organic solar cells, different type of organic solar cells, bulk heterojunction concept, electron transport and hole transport layers, Fabrication and characterization of organic solar cells, concept of exciton generation and dissociation, determination of electron and hole mobilities in the bulk heterojunction active layers, morphology of the active layer and characterization**	10
UNIT – IV **Dye sensitized solar cells, electron injection and regeneration of electrons and regeneration processes and characterization of dye sensitized solar cells, materials for these solar cells**	5
UNIT – V **Concept of perovskites based solar cells, different type of pervoskite solar cells, fabrication and characterization, advances in the pervoskites solar cells**	5
UNIT – VI **Organic light emitting diodes and field effect transistors**	5
UNIT – VII **Organic memory and switching devices**	5

Reference books :

1. Introduction to Organic electronics and optoelectronic Materials and Devices, Editors: S. s. Sun, L. R. Dalton, CRS press.
2. Organic Electronic Materials, manufacturing and application, Editors H. Klauk, Wiley Press
3. Organic Electronics Editor: T. Grasser and G. Meller, Springer-link Press
4. Additional materials (research papers and review articles) will be supplied by the Instructor time to time whenever is required

Evaluation Methods:

Item	Weightage
Assignments	20%
Presentations	30%
Final Examination	50%

Course Instructor: Prof. Ganesh Datt Sharma