

Department Elective Course-2 (DEC-2)

EC306: Flexible Electronics

Details of Course: -

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Flexible Electronics	3	1	0	Basics of Semiconductor Devices

Course Objective:

To introduce flexible electronic devices and their analog/digital/bio-medical applications, thin film transistor structural diversity, modeling, and parameters extraction, contact resistance and differential model, solar cell, organic LED and others so that the student is equipped to design and analyse a preliminary flexible electronic device/circuit.

Course Outcomes:

CO1:Identify different thin-layer materials for a flexible transistor, solar cells, and LED
CO2:Interpret structural diversity, operation, and characteristics of thin film transistor (TFT)
CO3:Determine analytical models and performance parameters for different TFT structures
CO4:Analyze Multilayer structures for flexible solar cells, LED, and their applications
CO5:Illustrate analog and digital electronic applications using flexible electronic devices

Details of the Course:

Unit	Content	Lecture Hours
1.	Introduction to Flexible Electronics, Benefits over conventional technology, Applications and Limitations. Organic Materials: Semiconductors (p-/n- type), Electrodes, Dielectrics, Substrates, Organic semiconductors, Charge Injection and Transport, concept of HOMO/LUMO, Solution processed fabrication techniques.	8
2	Thin Film Transistor: Structure. Operating Principle, Electrical Characteristics, Extraction of performance parameters, Classification of different Thin Film Structures: Single Gate, Dual Gate, Cylindrical, Vertical TFT, Front and Back Gate Biasing, Advanced structures for flexible transistor, Impact of structural Parameters on TFT performance.	10

3.	Contact Resistance: Origin of Contact Resistance and RC Model for flexible TFT, Resistance Extraction using TLM and Differential Model for linear and saturation regions, Analytical modeling for single gate, dual gate and cylindrical TFTs	8
4.	Organic LEDs: Electrical Characteristics, Multi-layered Architecture, Charge Blocking layers, Injection and Transport Layers, Organic solar cell: Structure, parameters, and characteristics. Applications: Display, sensors, bio-medical applications and Implantable bioelectronics	8
5.	Analog and Digital applications of Flexible TFT: Inverter design and characteristics, all-p DLL and ZVLL configurations for logic gates, Bootstrapping, Voltage Amplifier, all-p SRAM cell, OTFT driven OLED circuit.	8
TOTAL		42

Books:

1.	Hagen Klauk, Organic Electronics: Materials, Manufacturing and Applications, Wiley-VCH, 2006.
2.	B. K. Kaushik, B. Kumar, S. Prajapati and P. Mittal, Organic Thin Film Transistor Applications: Materials to Circuits, CRC Press, 2016.
3.	K. Mullen and U. Scherf, Organic Light Emitting Device: Synthesis Properties and Applications, Wiley-VCH, 2005.
4.	Hagen Klauk, Organic Electronics II: More Materials and Applications, Wiley-VCH, 2012.
5.	F. U. A. Nathan, Y. Wu and Beng S Ong, Organic Thin Film Transistor Integration, A Hybrid Approach, Wiley-VCH, 2011.