II B.Tech – II Semester
(20EC4630) NANO ELECTRONICS
(Honors)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
30	70	100	3	1	-	4

Pre-Requisites: Electronic Devices and Circuits

Course Objectives:
- To explain the types of nanotechnology, atomic structure, molecular technology and preparation of nano materials.
- To discuss the fundamentals of nano electronics and its properties.
- To know the basics of Silicon MOSFET's and Quantum Transport Devices
- To understand the fundamental concepts of carbon nano tubes.
- To describe the basics of molecular electronics and future applications.

UNIT–I: Introduction to Nano Technology
Introduction: Discussion of the International Technology Roadmap characteristics: Need for new concepts in electronics from microelectronics towards biomolecule electronics. Background: Types of nanotechnology and nanomachines, periodic table, atomic structure, molecules and phases, energy, molecular and atomic size, surface and dimensional space, top down and bottom up.

Molecular Nanotechnology: Electron Microscope, Scanning Electron Microscope, Atomic Force Microscope, Scanning Tunneling Microscope.

Nanomaterials: Preparation, Plasma Arcing, Chemical Vapor Deposition, Sol-Gels, Electrode Position, Ball Milling, Applications of Nanomaterials.

UNIT–II: Fundamentals of Nano Electronics
Fundamentals of logic devices – Requirements, dynamic properties, threshold gates; physical limits to computations; concepts of logic devices – classifications, two terminal devices, field effect devices, coulomb blockade devices, spintronics, quantum cellular automata, quantum computing, DNA computer; performance of information processing systems – basic binary operations, measure of performance processing capability of biological neurons, performance estimation for the human brain. Ultimate computation – power dissipation limit, dissipation in reversible computation, the ultimate computer.

UNIT–III: Silicon MOSFETs & Quantum Transport Devices
Silicon MOSFETs: Novel materials and alternate concepts, fundamentals of MOSFET Devices, scaling rules, silicon-dioxide based gate dielectrics, metal gates, junctions & contacts, advanced MOSFET concepts.
Quantum transport devices based on resonant tunneling: Electron tunneling, resonant tunneling diodes, resonant tunneling devices, Single electron devices for logic applications, Single electron devices, applications of single electron devices to logic circuits.

UNIT–IV: Carbon Nano Tubes
Fullerenes, types of nanotubes, formation of nanotubes, assemblies, purification of carbon nanotubes, electronic properties, synthesis of carbon nanotubes, carbon nanotube interconnects, carbon nanotube FETs, Nanotube for memory applications, prospects of all carbon nanotube nanoelectronics.

UNIT–V: Molecular Electronics

Electrodes & contacts, functions, molecular electronic devices, first test systems, simulation and circuit design, fabrication; Future applications – MEMS, robots, random access memory, mass storage devices.

Course Outcomes:

After successful completion of the course, the students can be able to

S.No	Course Outcome	BTL
1	Discuss the types of nanotechnology, molecular technology and the preparation of nano materials.	L2
2	Explain the fundamental concepts of the nano devices such as logic devices, field effect devices, and spintronics.	L2
3	Describe the concepts of silicon MOSFET and Quantum Transport Devices.	L2
4	Summarize the types, synthesis, interconnects and applications of carbon nano tubes.	L2
5	Understand the concepts, functions, fabrications and applications of molecular electronics.	L2

Correlation of COs with POs& PSOs:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	1	3	-	-	-	-	-	-	-	-	-	3	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	-	3	-	-	-	-	-	-	-	-	-	3	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	1	-	2	-	-	-	-	-	-	-	-	-	2	-

Text Books:

1. Nanotechnology: Basic Science and Emerging Technologies – Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Chapman & Hall / CRC, 2002.
2. Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices – Rainer Waser, Wiley-VCH, 2003.
3. NANO: The Essentials – T. Pradeep, McGraw Hill, 2007.

Reference Books:

1. Spin Electronics – M. Ziese and M.J. Thornton, Springer-verlag, 2001.
2. Quantum Based Electronic Devices and systems – M. Dutta and M.A. Stroscio, world Scientific, 2000.