IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC3OE08	NANOELECTRONICS *(Open Elective - III)*						

COURSE OBJECTIVES:

1. To gain knowledge and fundamental concepts of Nano Electronics.
2. To learn characteristics and microscopic structures.
3. To understand the fabrication techniques.
4. To learn the concept of carbon nano structures and its applications.
5. To understand the classification of nano sensors and its applications.

COURSE OUTCOMES:

After completion of the course, the student will be able to

CO1:.Describe the classification of nano structures with energy bands. [K2]

CO2:.Differentiate the scanning probe techniques and diffraction techniques. [K4]

CO3: Compare and contrast Quantum well width fluctuations and thermally annealed quantum well. [K4]

CO4: Summarize the features of carbon clusters and nano tubes. [K2]

CO5:.Differentiate the key features of NEMS and MEMS. [K4]

SYLLABUS:

UNIT–I: INTRODUCTION

Overview of nanoscience and engineering. Development milestones in microfabrication and electronic industry. Moore's law and continued miniaturization, Classification of Nanostructures, Electronic properties of atoms and solids: Isolated atom, Bonding between atoms, Giant molecular solids, Free electron models and energy bands, crystalline solids, Periodicity of crystal lattices, Electronic conduction, effects of nanometer length scale.

UNIT–II: CHARACTERIZATION

Characterization:

Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk and surface diffraction techniques.

Inorganic semiconductor nanostructures:

Overview of semiconductor physics. Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, electronic density of states.

UNIT–III: FABRICATION TECHNIQUES

Requirements of ideal semiconductor, epitaxial growth of quantum wells, lithography and etching, cleaved-edge over growth, growth of vicinal substrates, strain induced dots and wires, electrostatically induced dots and wires, Quantum well width fluctuations, thermally annealed quantum wells, semiconductor nanocrystals, colloidal quantum dots, self-assembly techniques.

UNIT–IV: CARBON NANOSTRUCTURES

Carbon molecules, Carbon Clusters, Carbon Nanotubes, application of Carbon Nanotubes.

UNIT–V: NANOSENSORS

Nanosensors:

Introduction, Order from Chaos, Characterization, Perception, Nanosensors Based On Quantum Size Effects, Electrochemical Sensors, Sensors Based On Physical Properties, Nanobiosensors, Smart dust Sensor for the future.

Applications:

Injection lasers, quantum cascade lasers, single-photon sources, biological tagging, optical memories, coulomb blockade devices, photonic structures, QWIP's, NEMS, MEMS.

TEXT BOOKS:

1. Robert Kelsall, Ian Hamley and Mark Geoghegan, Nanoscale Science and Technology, John Wiley, 2007.
2. Charles P Poole, Jr, Frank J Owens, Introduction to Nanotechnology, John Wiley, Copyright 2006, Reprint 2011.
3. T Pradeep, Nano: The essentials-Understanding Nanoscience and Nanotechnology, TMH.

REFERENCE BOOKS:

1. William A Goddard III, Donald W Brenner, Sergey E. Lyshevski and Gerald J Iafrate, Hand Book of Nanoscience Engineering and Technology, CRC Press, 2003.

WEB RESOURCES:

1. http://www.ewh.ieee.org/tc/nanotech/
2. http://www.nano.org.uk
3. http://www.library.ualberta.ca/subject/nanoscience/guide/index.cfm
4. http://www.avs.org
5. http://www.cientifica.eu
6. http://www.euspen.org
7. http://www.foresight.org
8. http://www.nanotec.org.uk
9. http://nanotechweb.org
10. http://www.ostp.gov/nstc/index.html