IV Year B.Tech. ECE I - Semester	L	T	P	To	C
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EC447 NANO ELECTRONICS
(Dept. Elective - IV)

Course Description & Objectives:

To introduce the students to nanoelectronics, nanodevices and molecular electronics.To identify quantum mechanics behind nano-electronics. To describe the principle and the operation of nano-electronic devices. To explain the principle and application of single electron devices.

Course Outcomes:

Upon successful completion of this course, students should be able to:

a. Explain the fundamental science and quantum mechanics behind nanoelectronics.
b. Explain the concepts of a quantum well, quantum transport and tunneling effects.
c. Differentiate between microelectronics and nanoelectronics.
d. Calculate the energy levels of periodic structures and nanostructures.
e. Summarize the applications of nanotechnology and nanoelectronics.

UNIT I - Introduction to Nano Electronics :

Basics of nanoelectronics – capabilities of nanoelectronics – physical fundamentals of nanoelectronics – basics of information theory – the tools for micro and nano fabrication – basics of lithographic techniques for nanoelectronics.

UNIT II - Fundamentals of Nano Electronics :

Quantum electron devices – from classical to quantum physics: upcoming electronic devices – electrons in mesoscopic structure – short channel MOS transistor – split gate transistor – Electron wave transistor – Electron spin transistor – quantum cellular automate – quantum dot array – Principles of Single Electron Transistor (SET) – SET circuit design – comparison between FET and SET circuit design.

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 :

Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes –assemblies – purification of carbon nanotubes – electronic propertics – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs –Nanotube for memory applications – prospects of an 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.

TEXTBOOKS :

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
2. T. Pradeep, NANO: The Essentials – Understanding Nanoscience and Nanotechnology, TMH, 2007.

REFERENCES :

1. George W.Hanson ,Fundamentals of nano electronics,PEARSON Education,2009.
2. Branda Paz, “A Handbook on Nanoelectronics”, Vedams books, 2008.
3. K.Goser, P.Glosekotter & J.Dienstuhl, “Nanoelectronic and Nanosystems – From Transistors to Molecular Quantum Devices” Springer, 2004.
4. W.R. Fahrner, “Nanotechnology and Nanoelectronics: Materials, Devices, Measurement Techniques”, Springer, 2010.
5. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.