Course code	Course name	L-T-P-Credits	Year of Introduction
AE468	NANO ELECTRONICS	3-0-0-3	2016

Course objectives

- To impart the basic concepts of nanotechnology
- To develop understanding about application of nanomaterials.

Syllabus

Introduction to nanotechnology and Nano electronics- fabrication of nano materials- Introduction to characterization tools of nano materials- basic properties of 2d semiconductor nanostructures- The concept of super lattices Kronig - Penney model of super lattice- Nanoelectonic devices and systems- Nanocomposites- nanofillers

Expected outcome

- At the end of the semester students will have good idea regarding nano electronics and their various applications.

Text books

1. J.M. Martinez-Duart,R.J. Martin Palma,F. Agulle Rueda "*Nanotechnology for Microelectronics and optoelectronics*" , Elsevier, 2006.
2. W.R. Fahrner,"*Nanotechnology and Nanoelctronics*", Springer, 2005

Reference books

1. Chattopadhyay,Banerjee, "*Introduction to Nanoscience & Technology*",PHI 2009
2. Diwanand and Bharadwaj,"*Nanoelectronics*",Pentagon Press Delhi 2006
3. Goser, P. Glosekotter, J. Dienstuhl, "*Nanoelectronics and nanosystems*", Springer 2004.
4. Poole*, "Introduction to Nanotechnology* ",John Wiley 2006
5. Pulikel M. Ajayan,"*Nanocomposite science and technology*", Wiley-VCH 2005
6. Supriyo Dutta, "*Quantum Transport- Atom to transistor*", Cambridge University Press, 2005.
7. T. Pradeep, "*Nano the Essentials*", TMH, 2007.

Course Plan

Module	Contents	Hours	Semester Exam Marks
I	Introduction to nanotechnology and Nano electronics, Impacts, Limitations of conventional microelectronics. Introduction to methods of fabrication of nano materials- different approaches. fabrication of nano-layers -Physical Vapor Deposition, Chemical Vapor Deposition, Epitaxy, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide. Fabrication of nanoparticle- grinding with iron balls, laser ablation, reduction methods, sol gel, self-assembly.	7	15%
II	Introduction to characterization tools of nano materials- - principle of operation of STM, AFM, SEM, TEM, XRD, PL & UV instruments. Mesoscopic Physics and Nanotechnologies - trends in Microelectronics and Optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence, Quantum wells,wires and dots, Density of states and dimensionality .	6	15%
FIRST INTERNAL EXAMINATION			
III	The physics of low dimensional structures - basic properties	7	15%

	of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells, quantum wires and quantum dots. Semiconductor quantum nanostructures and super lattices – MOSFET structures, Heterojunctions, Quantum wells, modulation doped quantum wells, multiple quantum wells.		
IV	The concept of super lattices Kronig - Penney model of super lattice. Transport of charge in Nanostructures under Electric field - parallel transport, perpendicular transport, quantum transport in nanostructures. Transport of charge in magnetic field and quantum Hall effect - Effect of magnetic field on a crystal, the Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.	7	15%
SECOND INTERNAL EXAMINATION			
V	Nanoelectonic devices and systems - MODFETS, heterojunction bipolar transistors, resonant tunnel effect, RTD, RTT,hot electron transistors, Coulomb blockade effect and single electron transistor, CNT transistors, heterostructure semiconductor laser, quantum well laser, quantum dot LED, quantum dot laser, vertical cavity surface emitting laser, quantum well optical modulator, quantum well sub band photo detectors, Infrared detector, Nano switches, principle of NEMS..	8	20%
VI	Nanocomposites, nanofillers, high performance materials, polymer nanocomposites, nanoclays, nanowires, nanotubes, nanoclusters etc. Smart materials, self-assembly of materials, safety issues with nanoscale powders.	7	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks:100 Exam Duration: 3 Hours

Part A

Answer any two out of three questions uniformly covering Modules 1 and 2 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part B

Answer any two out of three questions uniformly covering Modules 3 and 4 together. Each question carries 15 marks and may have not more than four sub divisions.

(15 x 2 = 30 marks)

Part C

Answer any two out of three questions uniformly covering Modules 5 and 6 together. Each question carries 15 marks and may have not more than four sub divisions.

(20 x 2 = 40 marks)