QUANTUM EFFECTS IN SEMICONDUCTOR PHYSICS

(Elective Subject)

Course Code:	13B1WEC834	**Semester:**	8th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

1. About the physics of semiconductors and their devices, including aspects of growth, transport and optical characterization.
2. Describe the basic science behind the properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.
3. Communicate clearly, precisely and effectively using conventional scientific language and mathematical notation.
4. Systematically solve scientific problems related specifically to nanotechnological materials using conventional scientific and mathematical notation.
5.

Course Outcomes

After completing the course students

1. Will have broad knowledge in the chosen discipline, with deep knowledge in its core concepts.
2. Will have knowledge in at least one discipline other than his/her primary discipline and some understanding of interdisciplinary linkages.
3. Will demonstrate well-developed problem solving skills, applying your knowledge and using his /her ability to think analytically and creatively.
4. Will develop a capacity for independent and self-directed work.
5. How to distill information from research articles and give scientific presentations.

Course Content

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1	Review of Quantum Mechanics Classical particles, Classical waves, Wave–particle duality, The Schrödinger wave equation, Wave mechanics of particles, Atoms and atomic orbital.	M. S. Tyagi & B.G. Streetman	6
2	Materials for nanoelectronics Semiconductors, Crystal lattices: bonding in	V.V.Mitin	

	crystals(Periodic structures, Cubic lattice, diamond lattice), Electron energy bands, Effective density of states, Semiconductor heterostructures, Lattice-matched and pseudomorphic heterostructures, Organic semiconductors, Carbon nanomaterials: nanotubes and fullerenes.	& S.M.Sze	8
3	Growth, fabrication, and measurement techniques for nanostructures Bulk crystal and heterostructure growth, Epitaxial growth, lattice matching in epitaxial growth, liquid phase epitaxy, Chemical- vapor deposition, molecular beam epitaxy, Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices, Techniques for characterization of nanostructures, Atomic force microscopy,Transmission electron microscopy, Scanning electron microscopy, Spontaneous formation and ordering of nanostructures, Clusters and nanocrystals, Methods of nanotube growth (Arc discharge and laser ablation, chemical vapor deposition, Directed growth of single-walled nano tubes., Chemical and biological methods for nanoscale fabrication, Fabrication of nanoelectromechanical systems.	V. V. Mitin & B.G. Streetman	10
4	Electron transport in semiconductors and nanostructures Time and length scales of the electrons in solids, Statistics of the electrons in solids and nanostructures, The density of states of electrons in nanostructures, Electron transport in nanostructures	V. V. Mitin	7
5	Electrons in traditional low-dimensional structures Nanostructures and quantum confinement, Electrons in quantum wells, Electrons in quantum wires, Electrons in quantum dots, Single electron transport.	V. V. Mitin	7

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks

3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
   - 10 Marks : Class performance, Tutorials & Assignments
   - 10 Marks : Quizzes
   - 5 marks : Attendance

Text Books

1. V.V.Mitin, V. A. Kochelap and M.A. Stroscio, Introduction to Nanoelectronics
2. B.G. Streetman: Solid State Electronic Devices, 5th Ed., Prentice Hall, 2000
3. S.M.Sze: Semiconductor Devices: Physics & Technology, John Wiley, 2002.
4. M.S. Tyagi, Introduction to Semiconductor materials & Devices, John Wiley, 1991

Reference Books

1. Eric L. Michelsen: Quirky Quantum Concepts, Online book, physics.uesd.edu/~emichels
2. Marius Grundmann: The Physics of Semiconductors, Springer