PPH422 NANO-MATERIALS

L	T	P	Cr
3	1	0	3.5

Course Objectives: Understand (i) the influence of dimensionality of the object at nanoscale on their properties; (ii) size and shape controlled synthesis of nanomaterials and their future applications in industry.

Introduction to Nanomaterials: Features of nanosystems, Characteristic length scales of materials and their properties, Density of states in 1-D, 2-D and 3-D bands, Variation of density of states and band gap with size of crystal.

Quantum Size Effect: Electron confinement in infinitely deep square well, Confinement in one dimensional well, Idea of quantum well structure, Formation of quantum well, Quantum dots and quantum wires.

Synthesis Methods: Top-down and bottom-up approach, cluster beam evaporation, ion beam deposition, chemical bath deposition with capping techniques, mechanical milling, chemical methods and self-assembly

Properties of Nanomaterials: Size and shape dependence of optical, electronic, photonic, mechanical, magnetic and catalytic properties.

Nanomaterials and their applications: Nanoparticles, Nanocoatings and Nanocomposites, Nanotubes, Fullerenes, Thin film chemical sensors, gas sensors, biosensors, Carbon fullerenes and Carbon nanotubes, Thin film chemical sensors, biosensors, Solar cells, Drug deliveries and optoelectronic devices.

Course learning outcomes: Students will have achieved the ability to:

1. explain the effects of quantum confinement on the electronic structure and corresponding physical and chemical properties of materials at nanoscale.
2. choose appropriate synthesis technique to synthesize quantum nanostructures of desired size, shape and surface properties.
3. correlate properties of nanostructures with their size, shape and surface characteristics.
4. appreciate enhanced sensitivity of nanomaterial based sensors and their novel applications in industry.

Recommended Books:

1. *Bimerg, D., Grundmann, M., and Ledentsov, N.N., Quantum Dot Heterostructures, John Wiley (1999).*
2. *Poole,C.P., Owens,F.J., Introduction to NanotechnologyJohn Wiley &Sons (2003)*
3. *Jain, K.P., Physics of Semiconductor Nanostructures, Narosa (1997).*
4. *Fendler, J.H., Nano particles and Nano-structured Films, John Wiley &Sons (1998).*
5. *Timp, G., Nanotechnology, Springer-Verlag (1999).*

Evaluation Scheme:

Sr. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessionals (May include assignments/quizzes)	25