

## PPH318: NANOMATERIALS

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<b>3</b>	<b>1</b>	<b>3</b>	<b>5.0</b>

**Course Objectives:** Aims at making the students to understand the various concepts of nanosized materials, their morphology, nomenclature and classifications along with different physical and chemical approaches used for their synthesis as well as their applications.

**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 Methodologies:** Sol-gel., Micromulsion, CVD, Molecular beam epitaxy, Vapor (solution)-liquid-solid growth, (VLS or SLS), Spary Pyrolysis, Lithography.

**Effect of Nanoscale on Properties:** Novel properties of nanomaterials-size and shape dependent optical, electronic, photonic, mechanical, magnetic catalytic properties.

**Nanostructures:** Carbon fullerenes and Carbon nanotubes, Self-assembly of nanostructures, Core-shell nanostructures, Nano composites nanocoatings, Thin film chemical sensors, biosensors, Photonic crystals, Smart materials, Fuel and solar cells, Drug deliveries and optoelectronic devices.

**Laboratory Assignments:** Familiarizing regarding various synthesis and characterization techniques for nanostructures.

### **Course Learning Outcomes (CLO):**

Students will have understanding of:

- 1 different type of nanomaterials, and their synthesis techniques
- 2 size dependence of various properties
- 3 various applications and perspectives of nanotechnology in the development of value added new products and devices

### **Recommended Books:**

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