

## PH 542: NANO SCIENCE AND TECHNOLOGY (4-0-0: 4)

### Background to Nanotechnology

Scientific revolution- Physics of low-dimensional materials, atomic structures, 1D, 2D and 3D confinement, density of states, excitons, Emergence of nanotechnology, challenges in nanotechnology. Carbon age: New form of carbon (from graphene sheet to CNT). Risks and benefits of nanomaterials

### Different Classes of Nanomaterials

Carbon nanotubes (CNT), metals (Au, Ag), metal oxides (TiO<sub>2</sub>, CeO<sub>2</sub>, ZnO), semiconductors (Si, Ge, CdS, ZnSe), ceramics and composites, dilute magnetic semiconductor, size dependent properties, mechanical, physical and chemical properties.

### Nanostructure Fabrication

Top-Down approach: Lithography. Bottom-Up approach: PVD & CVD

### Nanoelectronics

Tunnel junction, coulomb blockade and single electron transistor, operating principle, technology and application, carbon based devices

### Nanobiotechnology

Protein-based nanostructures, engineered nanopores, DNA-based nanostructures, nanoparticle–biomaterial hybrid systems for bioelectronic devices, DNA–gold–nanoparticle conjugates.

### Text Books and References:

1. M. Kuno, "Introductory Nanoscience: Physical and Chemical Concepts", Garland Science
2. H. H. Gatzert, V. Saile and J. Leuthold, "Micro and Nano Fabrication: Tools and Processes", Springer
3. G. W. Hanson, "Fundamentals of Nanoelectronics", Pearson
4. C. M. Niemeyer and C. A. Mirkin, "Nanobiotechnology Concepts, Applications and Perspectives", Wiley-VCH