

EC IV: INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY

Unit 1: Background to nanotechnology

Scientific revolution- Atomic structures-Molecular and atomic size-Bohr radius – Emergence of Nanotechnology – Challenges in Nanotechnology - Carbon age– New form of carbon. (from Graphene sheet to CNT)

Unit 2: Nucleation

Influence of nucleation rate on the size of the crystals- macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches-self assembly process-grain boundary volume in nanocrystals-defects in nanocrystals-surface effects on the properties.

Unit 3: Types of Nanostructures

Definition of a Nano system - Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire-Core/Shell structures.

Unit 4: Nanomaterials and properties

Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO₂, CeO₂, ZnO) - Semiconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites - Dilute magnetic semiconductor- Biological system - DNA and RNA - Lipids - Size dependent properties - Mechanical, Physical and Chemical properties.

Unit 5: Applications of nanomaterials

Molecular electronics and nanoelectronics – Quantum electronic devices - CNT based transistor and Field Emission Display - Biological applications - Biochemical sensor - Membrane based water purification.

References:

1. M. Wilson, K. Kannangara, G. Smith, M. Simmons, B. Raguse, Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition, 2005.
2. C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), *The chemistry of nanomaterials: Synthesis, properties and applications*, Wiley VCH Verlag GmbH&Co, Weinheim, 2004.
3. Kenneth J. Klabunde (Eds), *Nanoscale Materials Science*, John Wiley & Sons, Inc, 2001.
4. C.S.S.R.Kumar, J.Hormes, C.Leuschner, *Nanofabrication towards biomedical applications*, Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
5. W. Rainer, *Nano Electronics and information Technology*, Wiley, 2003.
6. K.E.Drexler, *Nano systems*, Wiley, 1992.
7. G.Cao, Nanostructures and Nanomaterials: Synthesis, properties and applications, Imperial College Press, 2004.