

Unit 1 Introduction to Nano

Historical introduction, Bulk vs. nano size, The concept of nano and its evolution. Size-dependence of properties. Electronic structure theory of metals and semiconductors. Quantum size effects. Metal nanoparticles, semiconductor quantum dots, Nano porous materials – mesoporous and micro porous materials, carbon nanostructures: fullerenes, carbon nanotubes, micelles, bilayers, biological nanostructures.

Unit II Nanomaterials and Properties

Semiconductor nanoparticles optical and electronic properties, Nano porous materials – mesoporosity and micro porosity, Magic numbers, Surface Plasmon resonance, Mesoporous materials: SiO₂ and TiO₂ and their applications. Self-assembled nanostructures.

Unit III basics and scale of nanotechnology

(9 hours) Introduction – Scientific revolutions – Time and length scale in structures – Definition of a nano system – Dimensionality and size dependent phenomena – Surface to volume ratio – Fraction of surface atoms – Surface energy and surface stress- surface defects- Properties at nanoscale (optical, mechanical, electronic and magnetic).

Unit IV Nanomaterials Synthesis and Applications

General: Top down and bottom up approach, Chemistry of nanostructures and chemical synthesis -Wet chemical routes, solution phase and vapor phase synthesis, sol-gel synthesis. Synthetic methods for metal and semiconductor nanoparticles, Template-based synthesis of mesoporous metal oxides. Synthesis of carbon nanostructures and fullerenes, Special applications of semiconducting nanomaterials- Photo catalysis, super hydrophilicity, Self-cleaning applications, Dye sensitized solar cells and electrochromic device applications.

Unit V Surface chemistry and Catalysis of nanomaterials

Adsorption by solids, Factors influencing adsorption. Adsorption isotherms - Freundlich and Langmuir adsorption isotherms, BET theory of multilayer adsorption (no derivation). Application of adsorption. General principles of catalysis - Typical mechanism, Catalysis and reaction energetic, Catalytic materials. Types of catalysis – Homogeneous catalysis, Heterogeneous catalysis-adsorption and catalysis, Uni-molecular surface reaction- bimolecular surface reactions-Langmuir-Hinshelwood mechanism. Significance of catalysis. Catalytic Inhibitors, Poisons and Promoters.

TEXT BOOKS/ REFERENCES:

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