Subject Code : P8CHE9

Chemistry of Nanoscience and Nanotechnology

UNIT – I

Nanomaterials – An Introduction & Synthetic methods

Definition of nanodimensional materials - Historical milestones - unique properties due to nanosize,Quantum dots, Classification of Nanomaterials .General methods of synthesis of nanomaterials – Hydrothermal synthesis,Solvothermal synthesis,Microwave irradiation, sol – gel and Precipitation technologies, Combustion Flame-Chemical Vapor Condensation Process, gas Phase Condensation Synthesis,Reverse Micelle Synthesis, Polymer – Mediated Synthesis, Protein Microtube – Mediated SynthesisSynthesis of Nanomaterials using microorganisms and other biological agents, Sonochemical Synthesis, Hydrodynamic Cavitation.
Inorganic nanomaterials – Typical examples –nano TiO2 / ZnO/CdO/CdS ,
Organic nanomaterials – examples – Rotaxanes and Catenanes

UNIT – II

Techniques for Characterisation of nanoscale materials: Principles of Atomic force microscopy (AFM)-Transmission electron microscopy (TEM)-Resolution and scanning transition electron microscopy (STEM) Scanning Tunneling Microscopy (STM) Scanning nearfield optical microscopy (SNOM),Scanning ion conductance microscope, scanning thermal microscope, scanning probe microscopes and surface plasmon spectroscopy.

UNIT III

Reactions in Nanospace / Nanoconfinement / Nanocapsules- Cavitands, Cucurbiturils, Zeolites, M.O.Fs, Porous silicon, Nanocatalysis.

UNIT – IV

Carbon Clusters and Nanostructures

Nature of carbon bond – New carbon structures – Carbon clusters: Discovery of C_{60} – Alkali doped C_{60} – Superconductivity in C_{60} – Larger and smaller fullerenes. Carbon nanotubes: Synthesis – Single walled carbon nanotubes – Structure and characterization – Mechanism of formation – Chemically modified carbon nanotubes – Doping – Functionalizing nanotubes –Application of carbon nanotubes. Nanowires – Synthetic strategies – Gas phase and solution phase growth – Growth control – Properties.

UNIT V

Nanotechnology and nanodevices:

DNA as a nanomaterial, DNA – knots and junctions, DNA – nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase – DNA complexes. Molecular recognition and DNA based sensor. Protein nano array, nanopipettes, molecular diodes, self assembled nano transistors, nanoparticle mediated transfection.

References

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3. Kenneth J. Klabunde (Ed), Nanoscale materials in Chemistry, Wiley-Interscience, New York, 2001.
4. T. Pradeep, Nano: The Essentials in understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi, 2007.
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6. Bengt Nolting, Methods in modern biophysics, Springer-Verlarg, Berlin, First Indian Reprint, 2004. (Pages 102-146 for Unit II and 147 – 163 for Unit V)
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8. W. Kain and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John-Wiley R Sons, New York.
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