

MANGALORE UNIVERSITY
Department of Materials Science
MSc Materials Science

MSS 555: NANOSCIENCE AND NANOTECHNOLOGY – II (3 Credits)

Objectives: This course deals with the advanced concepts in the subject focusing on the properties of metal and semiconductor nanomaterials with emphasis on their applications in electronics and optics. Also, special nanomaterials such as fullerenes, carbon nanotubes and nanocomposites are introduced.

Expected course outcomes: Student is expected to gain a good knowledge of the size dependent properties of nanostructures which make them a unique class of materials. Further it is expected that a student attains a broad perspective of still newer materials of interest in this category, such as fullerenes and nanotubes.

Unit I

Metal Nanoparticles: Introduction. Optical, Electrical and Magnetic properties. Surface plasmon resonance. GMR and CMR materials. Spintronics Applications of metal nanoparticles.

Semiconductor Nanoparticles: Introduction. Optical properties- Band gap variation with size- Brus equation. Photoluminescence. Nonlinear optical processes. Applications of semiconductor nanoparticles.

14 hours

Unit II

Fullerenes: Preparation, properties, nanostructured fullerene films, applications.

Carbon Nanotubes: Introduction. Single-walled and multiple-walled nanotubes. Synthesis, Purification and Structure. Methods of opening and filling nanotubes. Physical properties. Non-carbon nanotubes. Applications of nanotubes. Biological applications of nanotechnology. Brief idea of Nanobiotechnology.

14 hours

Unit III

Nanocomposites: Introduction to composites and nanocomposites. Ceramic, Metal, Polymer Nanocomposites. Thin-Film and CNT-Based Nanocomposites. Polymer and rubber based nanoclay composites. Nanoscale Fillers - Nanofiber or Nanotube Fillers. Nanotube Processing. Inorganic Filler/Polymer Interfaces. Processing of Nanocomposites. Nanocomposites for electrical, optical and magnetic applications.

Mechanical Properties - Modulus and the Load-Carrying Capability of Nanofillers - Failure Stress and Strain Toughness. Glass Transition and Relaxation Behavior

Natural Nanocomposite Materials - Biologically derived synthetic Nanocomposites, Templating. Natural Nanobiocomposites, **Biomimetic Nanocomposites**. 14 hours

References

1. Nanoscale Materials – (Ed) L.M. Liz-Marzan and P.V.Kamat, (Kluwer, 2003)
2. Nanostructured Materials and Nanotechnology, (Ed) H. S. Nalwa, (Academic, 2002).
3. Introduction to Nanotechnology – C P Poole and F J Owens (Wiley- Intersci. 2006)
4. Nanotechnology and Nanoelectronics – W R Fahrner (ed) (Springer, N Delhi, 2006)
5. Quantum Dots - L.Jacak, P Hawrylak, A Wojs, (Springer 1997)
6. Physics of Low Dimensional Structures, J H Davis, (Cambridge 1998)
7. Nanostructured Magnetic Materials and Applications- Shi D et al (Springer, 2002)
8. Nanobiotechnology- Concepts, applications and Perspectives – Niemeyer C
9. Nanocomposite Science & Technology, Pulickal M. Ajayan et.al (Wiley-VCH, 2003)
10. Introduction to Nanocomposite Materials- Thomas Twardowski, (DEStech, 2001).
11. Polymer-Clay Nanocomposites, T.J. Pinnavaia, G.W. Beall, (Wiley, 2004)

