

**BHARATI VIDYAPEETH**  
**(DEEMED TO BE UNIVERSITY), PUNE, INDIA**  
**PhD Entrance Test – 2022**  
**SECTION-II: Nanotechnology - 50 Marks**

<b>UNIT No</b>	<b>Topics covered</b>
<b>UNIT-I</b>	<p><b>Nanomaterial Synthesis Methods</b>            Introduction to Nano scale materials - Synthesis and processing, method of nano structured material preparation – mechanical grinding, wet chemical synthesis – sol-gel processing, gas phase synthesis, gas condensation processing, chemical vapor condensation – nano composite synthesis – processing. Vapor deposition and different types of epitaxial growth techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography. RFplasma, Plasma arc technique, Ion sputtering, Laser ablation, Chemical Vapour Deposition method and Electro deposition, Biomimetic Approaches</p>
<b>UNIT-II</b>	<p><b>NanoStructures</b>            Introduction, length scale of different structures, definition of nanoscience and nanotechnology, fullerenes, CNTs, graphenes and inorganic nanostructures, the evolution of Nanoscience, quantum dots and electronic structure of various nanophase materials. Clusters of metals and semiconductors, rare gas and molecular clusters, nanowires and nanorods, size dependent properties, size dependent absorption, phonons in nanostructures. Quantum dots. Dendritic and supramolecular structures, metal nanocluster composites, glasses. Biological building blocks, bionanopolymers, self-assembly by Nature. Polypeptide nanowire and protein nanoparticles, nucleic acids, DNA helix. Examples of biological nanostructures, proteins, micelles and vesicles, proteins, Amphiphilicity as a driving force in synthesis of biological structures. Multilayers. Bio-nano interface.</p>
<b>UNIT-III</b>	<p><b>Properties Of Nanostructured Materials</b>            Influence of Nano structuring on Mechanical - Optical, electronic, magnetic and chemical properties –gramsize effects on strength of metals optical properties of quantum dots and quantum wires –electronic transport in quantum wires and carbon nano tubes -magnetic behavior of single domain particles and nanostructures-surface chemistry of tailored monolayer -self assembling. Nano Characterization, mechanical characterization, structural characterization</p>
<b>UNIT-IV</b>	<p><b>Nanomaterial Characterization</b>            Principle and Instrumentation of Thermogravimetry; Differential Thermal Analysis and Differential scanning calorimetry-Importance of thermal analysis for nanostructures. Scanning Probe microscopy – Atomic manipulations – Atomic force microscopy – Scanning probe lithography – Optical microscopy – Confocal microscopy – Fourier Transform Infrared (FTIR)Spectroscopy and Applications- Microwave Spectroscopy- Raman Spectroscopy and CARS Applications-Electron Spin Resonance Spectroscopy; New Applications of NMR Spectroscopy; Dynamic Nuclear Magnetic Resonance; Double Resonance Technique. Spectroscopy of semiconductors – Excitons – Infrared surface spectroscopy – Raman spectroscopy – Brillouin spectroscopy – Dynamic Light Scattering (DLS) – NMR Spectroscopy – ESR spectroscopy – Mossbauer spectroscopy.</p>
<b>UNIT-V</b>	<p><b>Applications of Nanotechnology</b>            Industrial applications of nanomaterials, in the areas of electronics, photonics, biology, health and environment, medicine, defence, chemicals, catalysts, textiles, etc. Application of nanotechnology in remediation of pollution, photocatalysis and</p>

	other nanocatalysts, greenhouse gases, global warming. Monitoring nanoparticles at work place and sensors used for this. Toxicity of nanoparticles, exposure to nanoparticles and CNTs and influence on respiratory systems.
<b>Text Books/References:</b>	
1	Mick Wilson, Kamali Kannargare., Geoff Smith, -Nano technology: Basic Science
2	Nanostructures and Nanomaterials: synthesis, properties and applications, G. Cao and Y.
3	Charles P. Poole, Frank J. Owens, -Introduction to Nanotechnology, Wiley Interscience, 2003.
4	Mark A. Ratner, Daniel Ratner, — <i>Nanotechnology: A gentle introduction to the next Big Ideal</i> , Prentice Hall P7R: 1st Edition, 2002.
5	Encyclopedia of nanoscience and nanotechnology, Edited by H.S. Nalwa, American Scientific Publishers, 2007
6	Nanotechnology book by Prof. (Ms) Sulabha Kulkarni
7	Nanoelectronics and nanosystems: from transistors to molecular and quantum devices, K. Gosser, P. Glosekotter and J. Dienstuhl, Springer 2005
8	Handbook of Thin Film Materials, volume 5, edited by H.S Nalwa, American Scientific Publishers, 2002
9	Nanoelectronics- principles and devices, M. Dragoman and D. Dragoman, Artech House publishers, 2005
10	Overview of Nanoelectronic Devices, D. Goldhaber Gordon, Proceedings of IEEE, volume 85, 1997
11	Nanoelectronics and Information Technology, W. Rainer, Wiley, 2003
12	Nanosystems, K.E. Drexler, Wiley, 1992
13	Science of fullerenes and carbon nanotubes, M.S. Dresselhaus and G. Dresselhaus, Academic press, 1996

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