Syllabus for Ph.D. Nanotechnology Entrance Examination

1. **Structure of Solids, Bonding in solids, Band Theory of Solids**

Relation Between Lattice Constant and Density, Hexagonal Close Packed(hcp) Structure, Commonly Occurring Crystal Structures, Reciprocal Lattice and Brillouin Zones, Miller Indices, Polymorphism, Grains, Grain Boundaries and Grain Size Determination, Nanostructured Materials, Quasicrystals, Metallic Glasses, Diffraction Techniques, Bonding in condensed Matter, Pauli’s Principle, Covalent Bond, Ionic Bond, Born-Haber Cycle, Metallic Bonding, van der Waals Bonding, Mixed Bonding, Correlation between Cohesive Energy, Bulk Modulus and Melting Points, Kronig-Penney One Dimensional Model, Origin of the Energy Bands, Concept of the Hole, Limitations of the Kronig-Penney Model and Application of the Band Structure Results.

1. **Nanobiotechnology**

Genome Structure & Organization, DNA Replication and DNA Repair, Gene Expression in Prokaryotes & Eukaryotes, Protein Synthesis, Modifications and Transport, Basic Concepts in Genetics, Applications of Nano-Materials in Biosystems, Nanomaterials and Diagnostics/Drug Delivery and Therapeutics, Nanomaterials and Toxicity Evaluation.

Overview of Nanobiotechnology - Historical perspective of Integration of biology, chemistry, and material science. Opportunities and Promises of nanobiotechnology. Functional Principles of Nanobiotechnology- Structure and functional properties of Biomaterials, Bimolecular sensing, Molecular recognition and Flexibility of biomaterials.

Protein and DNA based Nanostructures - Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events – Nanobioelectronic devices and polymer nanocontainers – Microbial production of inorganic nanoparticles – Magnetosomes. DNA based nanostructures – Topographic and Electrostatic properties of DNA and proteins – Hybrid conjugates of gold nanoparticles – DNA oligomers

Nanomaterials used in Biotechnology -

Nanoparticles, carbon nanotubes, quantum dots and buckyballs interface with biological macromolecules. Biological perspectives of nanomaterials – impact of nanomaterials in biological processes – tolerance by immune systems and toxicity. Nucleic acid Engineering- Modifications of DNA for nano-technological applications. Nanostruture assembly using DNA.

Nanotechnology in Agriculture and Food technology - Insecticides development using nanotechnology and Nanofertilizers. Nanotechnology in food processing, food safety and biosecurity, toxin and contaminant detection, Smart packaging.

Sd/-

Chairman

Admission Committee (Ph.D.), Department of Nanotechnology.