

Syllabus for Ph.D. Entrance Exam 2018
Interdisciplinary Nanotechnology Centre (INC)
Faculty of Engineering and Technology
Aligarh Muslim University

Eligibility: M.Sc. in Physics/Chemistry/Life Science/M. Tech (Nanotechnology)

Review of Nanotechnology, Ideas about building things with atom, possible application in science & technology, ethical aspects of nanotechnology. Methods of synthesis (physical, chemical and biological) of nanomaterials and their complete characterization (using XRD, TEM, SAED, SEM, EDAX, XPS, UV-Vis, FTIR, PL, etc.). Popular nanomaterials such as graphene, carbon nanotubes, fullerene, quantum dots and polymer nanoparticles.

Size and dimensionality effects, size effects, conduction electrons and dimensionality, Fermi gas and density of states, potential wells, partial confinement, properties dependent on density of states and excitons.

Amorphous, crystalline, crystals, polycrystals, symmetry, unit cells, crystal structures (Bravais Lattices), crystallographic directions, crystallographic planes, Miller Indices, Bragg's Law, single crystal and powder x-ray diffraction.

Atomic bonding in solids, types of bond: metallic, ionic, covalent & Venderwaals bond, hybridisation and molecular orbital theory for simple & diatomic molecules.

Different types of materials: metals, semiconductors, composite materials, ceramics, alloys and polymers.

Imperfections of crystal structure: point defects, grain boundaries, phase boundaries, dislocations screw, edge and mixed dislocations, generation of defects by quenching, by plastic deformation and by radiation, Interaction between point defects and dislocations. The first and second laws of thermodynamics. Thermodynamic functions, heat capacity, enthalpy, entropy, equilibrium in one phase system, real gasses, the reactions between gases, reactions of solid state phases, phase rule, phase diagram, reaction kinetics and rate equations.

Structure and organization of typical animal cell, dimensions of biomolecules and cells, structure and conformational properties of protein, nucleic acid and other biomolecules, cell surface receptor and their specific ligands, antigen antibody interaction, blood brain barrier and fundamentals of tissue engineering.

Natural and artificial synthesis of nanoparticles in microorganisms; use of microorganisms for

nanostructure formation and testing of environmental toxic effect of nanoparticles using microorganisms.

DNA as functional template for nanocircuitry, Protein based nanocircuitry, neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation, DNA based nanomechanical devices, biosensor and biochips.

Targeted, non-targeted delivery, controlled drug release, exploiting novel delivery routes using nanoparticles, gene therapy using nanoparticles; nanostructures for use as antibiotics, diseased tissue destruction using nanoparticles.

Nucleus, cytoplasm, the chemical nature of cell, enzymes, establishment of DNA as the genetic material, extranuclear genomes, karyotype, genome and proteome, RNA, electrophoresis, southern blotting, nucleic acid hybridization, cDNA preparation, Polymerase chain reaction, reverse transcription-PCR, restriction fragment length polymorphism, DNA fingerprinting, random amplification of polymorphic DNA (RAPID), DNA sequencing, DNA microarray, genomic library and cDNA Library, Site-directed mutagenesis, tools required for tissue culture, methods of sterilization, Preparation of culture media for tissue culture, techniques of clonal propagation, organogenesis, protoplast fusion, somatic hybridization, anther and pollen culture, embryo culture and synthetic seeds.