AURCET - SYLLABUS
PAPER
NANOTECHNOLOGY

1. INTRODUCTION TO NANOTECHNOLOGY

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bionano-particles.

Interaction between bimolecules and naoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Nanosensors, Nanomedicine: Nanotechnology in Diagnostics applications, materials used in Diagnostics and Therapeutic, Environmental and Agricultural Applications of nanotechnology.

2. NANOMATERIALS and NANOBIOTECHNOLOGY

Biology inspired concepts – biological networks-biological neurons- the function of neuronal cell- biological neuronal cells on silicon modelling of neuronal cells by NLSI circuits – bioelectronics- molecular processor – DNA analyzer as biochip – molecular electronics; Nano biometrics – Introduction – lipids as nanobricks and mortar: proteins-three dimensional structures using a 20 aminoacid-biological computing – a protein based 3D optical memory using DNA to build nano cubes and hinges – DNA as smart glue – Nnanotechnology in Agriculture (Fertilizers and pesticides).

3. SYNTHESIS OF NANOMATERIALS

Biosynthesis of Nanoparticles, Microbial Nanoparticle production Biomineralization, Magnetosomes, Nanoscale magnetic iron minerals in bacteria, virus & fungi. DNA based Nano structures. Protein based Nano structures.

Structure and organization of prokaryotic and eukaryotic cell (Animal cell & plant cell), – Application of plant Transformation for Productivity and performance – **Green House Technology**. Animal Cell Culture Technology – Applications of Animal Cell Culture-Stem Cell Culture, Artificial organ synthesis,

Biosynthesis of Nanoparticles, Microbial Nanoparticle production Biomineralization, Magnetosomes, Nanoscale magnetic iron minerals in bacteria, virus & fungi. DNA based Nano structures. Protein based Nano structures.

4. TOXICITY AND SAFETY OF NANOMATERIALS

Concept of Nanotoxicology - Laboratory rodent studies - Ecotoxicologic studies – Methodology for Nanotoxicology - toxicity testing; Mechanism of nanosize particle toxicity - Reactive oxygen species mechanisms of NSP toxicity - Interactions between Nanoparticles and Living Organisms:

Mechanisms and Health Effects -
Interactions of Nanoparticles with Cells and their Cellular Nanotoxicology - Cytotoxicity of Ultrafine Particles - Cytotoxicity and Potential Mechanism of Nanomaterials
Assessment of human health risks associated with the use of nanotechnologies and nanomaterials in the food and agriculture sectors, safety, current risk assessment approaches used by FAO/WHO, environmental, ethical, policy and regulatory issues
Human exposure to Nanosized Materials
Biological Activities of Nanomaterials and Nanoparticles - Respiratory Tract - Efficient deposition of inhaled NSPs. - Disposition of NSPs in the respiratory - Disposition of NSPs in the respiratory -Epithelial translocation - Translocation to the circulatory system - Neuronal uptake and translocation -Translocation of NSPs in the blood circulation to bone marrow in mice - Studies of neuronal translocation of UFPs from respiratory tract - Exposure via GI Tract and Skin
Nanopolution: Nanomaterials in Environment - Toxicology of Airborne – Manufactured nanomaterials in the environment
Molecular Manufacturing – Nano simulation; Is nanotechnology bad or good? – Environmental issues – Need for regulation – Societal implications:
– Potential benefits and risks for developing countries – Intellectual property issues –

5. APPLICATIONS OF NANOTECHNOLOGY IN MEDICINE

Biosensors- DNA based biosensors – Protein based biosensors – materials for biosensor applications- fabrication of biosensors—future potential
Applications of nano-medicine: Bio- Pharmaceuticals, biological implants, diagnostic tools, Genetic testing – imaging – nanoparticles probe; Microfabricated drug delivery systems: microneedles- micropumps-microvalves-implantable microchips, Nanocarriers : drug delivery : sustained / controlled/ targeted
polymeric micelles as drug carriers – dendrimers as nanoparticulate drug carriers - nanocapsules preparation, characterization and therapeutic applications; Liposomes for genetic vaccines and cancer therapy - recent advances in microemulsions as drug delivery vehicles, lipoproteins as pharmaceutical carriers, solid lipid nanoparticles as drug carriers
Tumor detection and targeting in vivo, Gene Therapy using nanoparticles

6. CHARACTERIZING NANO PARTICLES ANALYTICAL TECHNIQUE

Properties and Characterization of Bionanomaterials
Use of AFM, SEM , TEM, XRD based bionanomaterial characterization, Properties of DNA structure as nanotechnology aspects, Surface modification properties of Cell, antibodies,antigens, proteins, enzymes.
Optical absorption and emission spectroscopy – Basics - AAS – ICP OES – Electron Microscopy: Scanning electron microscopy – Transmission electron microscopy – Scanning tunneling electron microscopy –

Molecular Spectroscopy and Differences-With Atomic Spectroscopy-Infrared (IR) Spectroscopy NMR Spectroscopy – ESR spectroscopy –Mossbauer spectroscopy
Fine Structure (XAFS) – Extended X- ray absorption fine structure (EXAFS) –., X-ray powder diffraction –structure analysis –

7. SAFETY OF NANO PARTICLES: ENVIRONMENTAL CONCERNS OF NANOMATERIALS

Identification of Nano - Specific Risks- Responding to the Challenge -Human health hazard – Risk reduction – Standards – Safety – transportation of NP– Emergency responders. Risk assessment –Environmental Impact – Predicting hazard – Materials Characterization. Risk Assessment related to nanotechnology – Environmental and policy making – Ecotoxicity measurement of Polychlirinated biphenyl and intermediates in their degradation
. **Risk assessment** – Ethical – Legal and Social Implications -
Nanoparticle Toxicology and Ecotoxicology, The Role of Oxidative Stress –
Development of Test Protocols for Nanomaterials – Regulation of Engineered Nanomaterials in

8. BIONANOMATERIALS

Natural and artificial (Microbial Nanoparticles production,Viral Nanoparticles production, Plant and diatoms Nanoparticles production), DNA, peptide, Protein ,enzyme based manufacturing: Nano particles with biosystems ,Natural biocomposite :spider silk:Bone :shells,CNT based biomaterials: using cnt as a template, Biosensors:using Nano materials with bio systems(Plant and animal cell, DNA, microtubules, antibodies, antigens etc..).Cellular imaging. Bionanoarrays: DNA,Protein, nucleotide based, viruses . DNA based computation . DNA as functional template for nanocir Biochip. Magnetic Nanoparticle by bacteria: mechanism of formation, application.