

CENTRAL UNIVERSITY OF JAMMU

DIRECT RECRUITMENT OF ASSOCIATE PROFESSOR IN NANOSCIENCE AND MATERIALS

WRITTEN TEST SYLLABUS

SECTION 1: Introduction to materials, classification of materials, bonding in materials: metallic, ionic, covalent and mixed bonding; structure of materials: fundamentals of crystallography, symmetry operations, crystal systems, Bravais lattices, unit cells, primitive cells, crystallographic planes and directions; structures of metals, ceramics, polymers, amorphous materials and glasses.

SECTION 2: Quantum confinement of electrons in semiconductor nanostructures- 3D, 2D, 1D and zero dimensional structures ; Size effect and properties of nanostructures; Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots.

SECTION 3: Top down and Bottom up approach; chemical methods- colloids and colloidal solutions; growth of nanoparticles; sol-gel methods; combustion methods; ball milling; template synthesis; X-ray and e- beam nano-lithography. Langmuir-Blodgett growth

SECTION 4: X-ray diffraction-peak broadening; Scherer formula; Transmission and scanning electron microscopy, Atomic force microscopy; UV-VIS spectroscopy- blue shift and band gap calculation; fluorescence spectroscopy; photoconductivity.

SECTION 5: Mechanical (elastic and hardness); structural; electrical; optical properties of metallic nanoparticles; semiconductor nanoparticles; magnetic properties of nanoparticles; Mass sensing- Nanogram Mass Sensing by Quartz Crystal Microbalance, MEMS/NEMS Resonators; Displacement sensor- Electron Tunneling Displacement Nanosensor, Coulomb Blockade Electrometer-Based Displacement Nanosensor,

SECTION 6: Nanometer-Scale Displacement Sensing by Single-Electron Transistor, Magnetomotive Displacement Nanosensor, Piezoresistive and Piezoelectric Displacement Nanosensors, Optical Displacement Nanosensor; Femtonewton Force Sensors- Doubly Clamped Suspended Carbon Nanotube Resonators, Heat treatment of ferrous and aluminium alloys; preparation of ceramic powders, sintering;

Section 7: thin film deposition: evaporation and sputtering techniques, and chemical vapour deposition, thin film growth phenomena; Quantum Physics for Nanostructures, foundation of Nano photonics, 1-D, 2-D and 3-D Photonic crystal, Semiconductor Device Physics and Technology, MEMS to NEMS, Nanosensors. New Energy Technologies, Spintronics circuit design by nanotube and graphene; Theoretical and mathematical description of Photonic band gap, Features and fabrication of Photonic crystals.

Section 8: Applications of nano particles, quantum dots, quantum well laser; cosmetics; self cleaning glasses; Scratch free lenses; nanoparticles based solar cells and quantum dots based white LEDs ; CNT based batteries; ferrofluids, Molecular Electronics. Electromagnetics of Metallic Nano-particles; Plasmonic waveguides; Localized surface plasmons; Nanocontrol of Excitation Dynamics; Nanocomposites; Nanostructured Molecular Architectures; Micromagnetism and Nanoscale magnetism; Applications of nanomagnetism.