Name of Specialization: Nano Applications in Electro-Mechanical Engineering	
No. of Question: 50 (Objective Type)	
Duration: 1 Hr. 30 Min	Maximum Marks: 50

Bulk Nanostructured Materials: Solid disordered Nanostructures – Nanostructured crystals – Nanostructured Ferromagnetism; optical and vibrational spectroscopy; Infrared frequency range – Luminescence – Quantum wells, wires and Dots – Size and dimensionality effects – Excitons – Single electron tunneling – Applications – Superconductivity; Self-assembly and catalysis.

Review of the Laws of Thermodynamics and their Consequences, Statistical Description of Systems of Particles, Quantum mechanics Synthesis of Nonmaterial using Chemical methods, Mechanical methods, PVD, CVD, and MOCVD

Characterization Techniques: UV – Visible- NIR - absorption and reflectance Spectroscopy, X- Ray Diffraction studies – Bragg's law – particle size – Scherrer's equation – Photoluminescence (PL) studies – Brillouin spectroscopy – Dynamic Light Scattering (DLS) – NMR Spectroscopy – ESR Spectroscopy – photo electron spectroscopy(XPS)- SEM, TEM, STM, Atomic force microscopy(AFM).Fourier Transform Infrared Spectroscopy (FTIR) – FT Raman studies –Surface Enhanced Infrared spectroscopy, Resonance Raman Spectroscopy,

Quantum electron devices – from classical to quantum physics: upcoming electronic devices – electrons in mesoscopic structure – short channel MOS transistor – split gate transistor – electron wave transistor – electron spin transistor – quantum cellular automate – quantum dot array – Principles of Single Electron Transistor(SET) – SET circuit design , Nanoelectronics with tunneling devices and superconducting devices – tunneling element technology - RTD: circuit design based RTD – Defect tolerant circuits

Sensor & Transducers, Conductometric and capacitive transducers – optical waveguide based transducers – optical fiber based transducers – Interferometric optical transducers – surface plasmon resonance transducers – electrochemical transducers – solid state transducers – PN diodes or bipolar junction based transducers – schottky diode based transducers – MOS capacitor based transducers – FET based transducers –Acoustic wave transducers – Quartz crystal microbalance – Film Bulk acoustic wave resonator (BAW transducer) – Interdigitally launched surface acoustic wave transducer (SAW transducer) – Cantilever based transducers.

Theoretical Basics of Carbon Nano tube, Preparation of Carbon Nano-Tubes, Properties of Carbon Nanotubes, Applications of Carbon Nanotubes, Dendrimers

Lithography –Optical lithography – Light sources – photo mask and alignment, Resolution in projection systems – positive and negative photo resists – ultraviolet lithography – X-ray lithography – Synchrotron radiation – Ion beam lithography. Microlithography – Microchips – Electron beam lithography – Ion beam lithography – Maskless lithography – immersion lithography – Semiconductor processing – MEMS design. Nanolithography, Nanosphere lithography – Molecular self-assembly Nanoimprint lithography, Dip-pen nanolithography, soft lithography, Stereo-lithography, nanoscale 3D shapes – NEMS design.