

**SARDAR PATEL UNIVERSITY**  
**Programme & Subject: M.Sc (Physics)**  
**Semester: III**  
**Syllabus with Effect from: June - 2014**

<b>Paper Code: PS03CPHY02</b>	<b>Total Credit: 4</b>
<b>Title Of Paper: Nano - Science &amp; Thin - Film Physics</b>	

Unit	Description in detail	Weightage (%)
I	Synthesis: metal colloids, nanoclusters, carbon nanotubes, nanocrystalline materials, oxide nanoparticles, Preparation of quantum nanostructures (quantum wells, quantum wires and quantum dots), Characterization: Transmission electron microscopy (TEM), High Resolution TEM (HRTEM), Particle Size Analyzer, Scanning tunneling microscopy (STM), Atomic-force microscopy (AFM), Scanning near field optical microscopy (SNOM), Raman Spectroscopy and Photoluminescence. Applications: Single electron tunneling, IR detectors, quantum dot lasers, targeted drug delivery using nanoparticles, nanosensors based on quantum size effects.	25%
II	Theory of thin film nucleation - Impingement, adsorption and thermal accommodation, The capillarity model, Atomistic model, Four stages of thin film growth, cluster coalescence and depletion, thickness measurement by QCTM and Stylus profilometry methods. Lithography: photo, X-ray and e-beam.	25%
III	Thermal evaporation, sputtering: DC, Radio frequency and magnetron, e-beam deposition methods, ion plating, ionized cluster beam deposition. CVD reaction types, PECVD, LECVD, MOCVD, HTCVD, Molecular beam epitaxy (MBE), Liquid Phase epitaxy (LPE), Vapour phase epitaxy (VPE).	25%
IV	Classification of thin film characterization techniques, X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), Low energy electron diffraction (LEED), Reflection high energy electron diffraction (RHEED), Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), RBS (Rutherford back scattering), SIMS (Secondary ion mass spectrometry), Applications: thin film solar cells, Micro-electromechanical systems (MEMS) and Nano-electromechanical systems (NEMS).	25%

**Basic Text & Reference Books:-**

- Nano-science and Technology by V.S. Muralidharan and A. Subramania (Ane Book Pvt. Ltd.).
- Introduction to Nanotechnology by Charles P. Poole, and Frank J. Owens (Wiley India Pvt. Ltd).
- Handbook of thin film technology by L.I. Maissel and R. Glang (McGraw-Hill).
- The Materials Science of thin films by Milton Ohring (Academic press).
- Integrated circuits by K. R. Botkar (Khanna Publishers).
- Thin Film Phenomena by K. L. Chopra (McGraw-Hill).
- Nano: The Essentials –Understanding Nanoscience and Nanotechnology by T. Pradeep (McGraw-Hill Education).
- Thin Film Solar Cells by K. L. Chopra and S. R. Das
- Semiconductor material and Devices Characterization, By Dieter K. Schroder, John Wiley and Sons, NY1990.
- Surface Science: An Introduction By K. Oura, V.G. Lifshits, A. A. Saranin, A. V. Zotov and M. Katayama, Springer-Verlag, 2003.

