Sankalchand Patel University

Faculty of Science & Humanities

Master of Science (Physics) (Sem-3)

In Effect from Academic Year 2022-23

Subject Code: 1SC2050302	**Subject Title: Nano Science and Thin Film**

COURSE OBJECTIVE:

Physics is a science to understand the nature. This course is designed to get basic understanding of the physical world.

LEARNING OUTCOMES:

- To develop understanding of Nano science and thin film.

Teaching scheme (hours) per week		**Credit**		**University Examination**		**Internal Examination**		**Total**
Theory	**Practical**	**Theory**	**Practical**	**University Assessment**	**Practical**	**Internal Assessment**	**Practical**	
4	**--**	**4**	**--**	**60**	**-**	**40**	**---**	**100**

Unit	**Content**	**Lectures**	**Weight (%)**
1	Introduction : Nanoscience and nanotechnology, nanostructures in nature, quantumstructures, quantum confinement, surface effects of nanomaterials, Nanomaterials synthesis : Arc discharge method, laser ablation, aerosol synthesis, inert gascondensation, high energy ball milling, chemical vapour deposition, Reverse micellar/microemulsion method, sol-gel method, Preparation of quantum nanostructures by lithography: photo, X-ray ,ion beam (FIB), neutral beam, and electron-beam,dip pen lithography. Characterization techniques of Nanostructures: Transmission electron microscopy (TEM), High Resolution TEM (HRTEM), Particle Size Analyzer, Scanning tunneling microscopy (STM), Atomic-force microscopy(AFM).	15	25
2	Characterization techniques of Nanostructures : Scanning near field optical microscopy(SNOM), Spectroscopy of semiconductors: Excitons, Infrared surface spectroscopy,Raman Spectroscopy, Brillouin spectroscopy and Luminescence. Applications ofnanostructures: Single electron tunneling, IR detectors, quantum dot lasers, , medicine,targeted drug delivery ,high energy density batteries, next generation computer technology, Electronics, phosphors for high definition TV, low cost flat panel displays, water purification, communication sector, food, fabric industry, environment, automobiles, tougher and harder cutting tools.	15	25
3	Physics and chemistry of evaporation, evaporation rate, vapour pressure of elements, evaporation of compounds, evaporation of alloys, Deposition technology, Thermal deposition in vacuum, kinetic theory of gases and emission condition, distribution of deposit, resistance heating, thermal evaporation, flash evaporation, multi evaporation sources, RF and Induction heating, electron beam method, sputtering-ion surface	15	25

	interactions, sputter yield, sputtering of alloys, cathodic sputtering, glow dischargesputtering, low pressure sputtering, reactive sputtering.		
4	Hybrid and modified PVD processes : Ion plating, reactive evaporation processes, Ionbeam assisted deposition processes, Ionized cluster beam deposition. Introduction to chemical vapour deposition and its reaction types : Pyrolysis, reduction, oxidation,compound formation, disproportionation, reversible transfer, Optical methods of measuring thin film thickness : FET, FECO, VAMFO, step gauges, ellipsometry,Mechanical methods for measuring thin film thickness : Stylus profilometry, weight measurement, Quartz crystal oscillators.	15	25

Basic Reference book:

1. Principles of nanoscience and nanotechnology by M.A. Shah, Tokeer Ahmad (Narosapublishing house)
2. Nanomaterials : An introduction to synthesis,properties and applications by Dieter Vollath (Wiley-VCH Verlag GmbH & Co.KGaA)
3. Nanotechnology : Principles and practices : S. K. Kulkarni(Capital publishing company).
4. Nano-science and Technology by V.S. Muralidharan and A. Subramania (Ane Book Pvt. Ltd.).
5. Introduction to Nanotechnology by Charles P. Poole, and Frank J. Owens (Wiley IndiaPvt. Ltd).
6. Handbook of thin film technology by L.I. Maissel and R. Glang (McGraw-Hill).
7. The Materials Science of thin films by Milton Ohring (Academic press).
8. Nano: The Essentials –Understanding Nanoscience and Nanotechnology by T. Pradeep(McGraw- Hill Education).
9. Thin film fundamentals by A. Goswami (New age international limited publishers)