Sankalchand Patel University

Faculty of Science & Humanities

Master of Science (Physics) (Sem-4)

In Effect from Academic Year 2022-23

Subject Code: 1SC2050402	**Subject Title:** Advanced Experimental & Characterization Techniques

COURSE OBJECTIVE:

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

LEARNING OUTCOMES:

- Develop the understanding of Advanced Experimental & Characterization Techniques.

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	Thin film deposition techniques: Radio frequency and magnetron Sputtering, CVD reaction types, PECVD, LECVD, MOCVD, HTCVD, Introduction to Epitaxy, lattice misfit, epitaxy of compound semiconductors, Applications of epitaxy : Optical communications, Light emitting semiconductor devices (e.g. GaN), Molecular beam epitaxy (MBE), Liquid Phase epitaxy (LPE),Vapour phase epitaxy (VPE), Spray method : Spray Hydrolysis, Spray pyrolysis.	15	25
2	Principles of Cryo-cooling and Thermometry: Cooling techniques, Liquifaction of gases, Closed cycle refrigerators, sample helium bath cryostats, Dilution refrigerators, Pomeranchuk cooling, adiabatic demagnetization, nuclear spin demagnetization. Primarythermometers,3Hemelting-curve Thermometer, Superconducting fixed-point Thermometers, Nuclear- Orientation Thermometers. Secondary Thermometers: Resistance Thermometers,ThermoelectricElements,MagneticThermometers,NuclearSpin Resonance Thermometers.	15	25
3	Low and high resolution mass spectrometry, Chromatography-mass spectrometry, Tandem mass spectrometry, Gas chromatography, Liquid chromatography, Ion chromatography, gel permeation chromatography. Atomic absorption spectroscopy, emission spectrographic analysis, flame emission spectrometry, inductively coupled argon plasma emission spectroscopy, neutron activation analysis.	15	25
4	SAXS and SANS (small angle X-ray and neutron scattering, spectroscopy, synchrotron X-ray sources, SEM/EPMA(scanning electron microscopy, electron probe microanalysis) Scanning Auger microscopy(AES), SIMS (Secondary ion mass spectrometry), Ultraviolet and Bremsstrahlung isochromat spectroscopy, Angular dependent X-ray photoelectron spectroscopy. Low energy electron diffraction (LEED), Reflection high energy electron diffraction (RHEED), Electron energy loss spectroscopy (EELS), RBS (Rutherford back scattering).Graphical method, Method of least squares, Linear least square curve fitting.	15	25

Basic Reference book:

1. Handbook of thin film technology by L.I. Maissel and R. Glang (McGraw-Hill).
2. The Materials Science of thin films by Milton Ohring (Academic press).
3. Thin Film Phenomena by K. L. Chopra (McGraw-Hill).
4. Surface Science: An Introduction By K. Oura, V.G. Lifshitz, A. A. Saranin, A. V. Zotov and M. Katayama, Springer-Verlag, 2003.
5. Materials characterization and chemical analysis by John P. Sibilia.
6. Preparation of thin films by Joy GeorgePage 30 of 38
7. Nanotechnology : Principles and practices : S. K. Kulkarni(Capital publishing company).
8. Nanocharacterisation edited by Augus I kirkland and John L. Hutchison,
9. Low Temperature Physics: Christian Enns and Siegfried Hunklinger, Springer-Berlag Berlin (2005)
10. Matter and Methods at low Temperature (3rd edition): Frank Pobell, Springer-Verlag Berlin Heidelberg (2007).
11. Experimental Techniques in Low Temperature Physics (3rd Edition): Guy K. White, Clarendon Press, Oxford (1979)