Master of Science in Physics
M.Sc. (Physics) Semester II

Course Code	**PS02EPHY51**	Title of the Course	**Experimental methods in Solid State Physics**
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	1. Course describes different X-ray spectroscopy technique for material characterization and thermal analysis techniques to determine thermal stability and thermodynamic transitions of the materials. 2. Course depicts the different scintillation counters, ionization chambers, and detectors for the detection of the different radioactive particles. 3. The subject matter covered here will give students the fundamental ideas about low temperature physics. It also includes modern methods of generation and measurements of cryogenic temperatures. 4. To teach various sources of errors in experimental observations and to minimise them by methods of least square methods.

Course Content		
Unit	Description	Weightage* (%)
1	*Thermal Analysis:* Thermo gravimetric analysis, Differential thermal analysis and Differential scanning calorimetry, X-ray photoelectron spectroscopy, X-ray fluorescence spectroscopy, UV-Visible spectroscopy, atomic absorption spectroscopy.	25%
2	Ionization Chamber, Proportional Counter, Geiger-Mueller Counter, Scintillation detector: organic scintillator, Inorganic scintillator, Light guides, Photomultiplier tubes, Scintillation Spectrometer, Energy resolution of a scintillation spectrometer, Semiconductor detectors: Diode detector, Diffused junction detector, Surface barrier detector, Ion implanted layer detectors, Fully depleted detectors, Lithium doped germanium detector [Ge(Li)], High purity germanium detector	25%

	(HPGe), Cherenkov Detector, Photographic emulsion, Cloud Chamber, Bubble Chamber, Spark Chamber.	
3	Principles of Cryo-cooling and Thermometry: Cooling techniques, Liquefaction of gases, Closed cycle refrigerators, sample helium bath cryostats, Dilution refrigerators, Pomeranchuk cooling, Primary thermometers,3He melting-curve Thermometer, Superconducting fixed-point Thermometers, Nuclear- Orientation Thermometers. Secondary Thermometers: Resistance Thermometers, Thermoelectric Elements, Magnetic Thermometers, Nuclear Spin Resonance Thermometers.	25%
4.	*Basic Statistical concepts:* Types of measured quantities, Discrete quantities, Continuously distributed quantities, Histogram, Normalized histogram, Best estimate of true value of data, Standard deviation of the means, best estimate of uncertainty. *Normal Distribution:* Properties of Gaussian distribution, Area under the normal distribution curve, Determination of mean value for a Gaussian distribution, Determination of standard deviation for Gaussian distribution, Central limit theorem, Chi-square test for goodness of fit, Criteria for goodness of fit. *Graphical representation and curve fitting of data:* Graphical representation of functional relationships, Determination of parameters in linear relationships, Graphical method, Method of least squares, Linear least square curve fitting.	25%

Teaching-Learning Methodology	Lectures using traditional blackboard teaching, Tutorials, class assignments as well as the ICT tools for effective delivery of the content.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%

2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	On completion of the course the students will be capable of using different X-ray spectroscopy technique and thermal analysis technique for experimental research and they should be able to carry out data analysis related to these techniques.
2.	Students will be in a position to understand the various kinds counters, chambers, scintillators and detectors used for the detection of high energy particles experiments.
3.	Students will be able to understand the physical process related to cryogenic temperature, which is now a part of many advanced methods of solid state characterization techniques.
4.	When student perform experiment, they are able to resolve the different types of the error. If the observed values are non-linear then how make it straight line, so that they determine intercept and the slope graphically and by calculation accurately.

Suggested References:	
Sr. No.	References
1	Elements of X-ray diffraction Cullity and Stock (2001)
2	An introduction to lattice dynamic L.S Kothari (1972)
3	Biomedical instrumentation & measurements L. Cromwell (1980)
4	Instrumental method of analysis Willard (1988)

5	Fundamentals of Nuclear Physics Jagdish Varma, Roop Chand Bhandary, D.R.S. Somayajulu (2005)
6	Instrumentation, measurement and analysis. B. C. Nakra and K. K. Chaudhry (2003)
7	Low Temperature Physics Christian Enns and Siegfried Hunklinger, Springer-Verlag (2005).
8	Matter and Methods at low Temperature (3rd edition) Frank Pobell, Springer-Verlag Berlin Heidelberg (2007).
9	Experimental Techniques in Low Temperature Physics (3rd Edition) Guy K. White, Clarendon Press, Oxford (1979)

On-line Resources
www.sciencedirect.com www.researchgate.net › www.leybold-shop.com