Programme: M. Sc. Part-II (Chemistry)
Course Code: PCO-503
Title of the Course: Solid State Chemistry II: Characterization of solid materials
Number of Credits: 03 **Effective from AY:** 2019-20

Prerequisites for the course:	Students should have studied the course Solid State Chemistry I : Concepts and Application, so as to have basic knowledge of solids state chemistry.	No. of lectures/hours
Course Objectives:	1. To introduce solid state characterization methods and techniques. 2. To provide fundamental knowledge of principles and instrumentation involved in selected techniques. 3. To provide comparative evaluation of data obtained from various techniques and its use in elucidating the chemical and morphological structure of solid materials	
Course Outcomes:	1. Students should be in a position to understand the design of the instrumental techniques, data acquisition and storage. 2. Students should be able to understand the fundamental principles governing the technique, data interpretation and analysis to elucidate structural information of solid materials 3. Students should be in a position to understand and apply the concept learned to make the best choice of a characterization technique(s) for elucidation of unknown solids under investigation.	
Content:	1. **Thermal Analysis** 1.1Thermogravometric analysis, Differential Thermal Analysis 1.2 Differential scanning calorimetry 1.3 Application to characterization of materials **2. X – Ray Diffraction:** 2.1 The powder X-ray diffraction experiment, instrumentation 2.2 Intensities: scattering of X-Rays and factors that affect intensities, powder x-ray pattern 2.3 Introduction to single crystal x-ray diffraction. 2.3 Applications of high temperature powder diffraction. 2.4 Identification of crystal phases and evaluation of lattice characteristics 3. **Microscopic Techniques** 3.1 Introduction to Electron Microscopy: Generation of electron beam, elastic and inelastic scattering of electrons by atoms 3.2 Scanning Electron Microscopy (SEM): Instrumentation, optics, resolution and compositional imagining, acquisition and data storage. Preparation of specimen, crystallographic information from SEM and environmental scanning electron microscopy	5 hours 10 hours 6 hours

	3.3 High Resolution Transmission Electron Microscopy (HR-TEM): Instrumentation, contrast mechanism, high voltage and scanning transmission microscopy, preparation of specimen and data interpretation. 4. **Selected Spectroscopic Techniques** 4.1 Vibrational spectroscopy: IR and Raman spectroscopy, fundamental principle, instrumentation and design, applications to ferroelectric materials such as $LiNbO_3$ and $LiTaO_3$. 4.2 Visible and UV spectroscopy of solids: Fundamental principle, diffuse reflectance measurement, instrumentation and design, structural studies of transition metal oxides, glass and laser materials. 4.3 X ray Spectroscopy: XRF, XANES and EXAFS: Absorption coefficient, absorption edges, resonance emission, extended absorption and photoelectron scattering. Instrumentation and design, characterization of transition metal oxides. 4.4 Mössbauer Spectroscopy: Mössbauer effect, recoil free absorption and emission in solids, isomer shift, quadrupole splitting, magnetic splitting, instrumentation and design, characterization of Iron compounds.	15 hours
Pedagogy:	Mainly lectures, tutorials, assignments and presentations or a combination of some of these could also be used to some extent.	
Text Books / Reference Books	1. A. R. West, *Solid state chemistry and its applications*, John Wiley & Sons, 2005. *2.* D. Brandon & W. Kaplan, *Microstructural Characterization of Materials,* John Wiley & Sons, 1999. 3. P. J. Goodhew, J. Humphreys & R. Beanland *Electron Microscopy and Analysis*, Taylor and Francis, 2001. *4.* C. N. Banwell & E. M. McCash, *Fundamentals of molecular spectroscopy,* Mcgraw Higher Ed, 2016, 4th Ed.	