Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCYD528	Instrumental Techniques for Material Characterization	3	0	0	3

Course Objective
● With this course students will learn Principle, instrumentation and applications of various X-Ray, Microscopic and Thermal techniques for materials characterizations.
Learning Outcomes
● Characterize materials using advanced characterization techniques. ● Select and interpret analysis results. ● Design experiments with improved sample preparation, new measurement procedures and tools ● Utilize the concept of different materials characterization techniques for qualitative and quantitative analysis.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Principle, Instrumentation of XRD, XRF (EDS, WDS) and XPS. Crystal Structure determination by XRD. Qualitative and Quantitative elemental analysis by XRF. Surface chemical analysis by XPS. Neutron Diffraction for materials characterization.	14L	This unit will introduce the students to working principles, instrumentation and applications of XRD, XPS and XRF.
2	Resolution, magnification, depth of field, Imaging – theory and concepts. Principle, Instrumentation of Scanning electron microscopy, Transmission electron microscopy, Scanning Tunnelling Microscopy, Atomic Force Microscopy. Sample Preparation Techniques for microscopic analysis. Elemental analysis by EPMA. Electron energy loss spectroscopy (EELS) and selected area electron diffraction (SAED) in TEM.	20L	This unit will introduce the students to working principles, instrumentation and applications of SEM, TEM and SPM.
3	Advanced applications of XRD, XRF, XPS, SEM, TEM and SPM.	8L	This unit will introduce students to the applications of X-RAY and microscopic techniques.
TOTAL		**42**	

Reference Books:

1. Elements of X-Ray Diffraction, B.D. Cullity, S.R. Stock, Third Edition, Pearson, 2014.
2. Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Y.Leng, Wiley, 2008.