

**St. Aloysius' College (Auto.), Jabalpur**  
**Department of Physics**  
**Certificate Course on**  
**“Characterization Techniques in Material Science”**

**Credit: 2**

**Time Duration: 30 Hrs.**

**Course Outcome**

The students are expected to acquire the knowledge of the following:

- Fundamentals of crystallography.
- Lattice Planes and Miller Indices.
- X-ray: Production techniques and Nature, Bragg's Law.
- Parameters related to crystallography.
- UV-Vis Spectroscopy, Calculation of Energy Band Gap using Mathematica.
- Operation and Handling of X-ray Diffractometer and UV-Vis Spectrometer.

<b>Paper</b>		<b>Maximum Marks</b>	<b>Minimum Marks</b>	<b>Total Marks</b>
<b>I</b>	<b>Theory</b>	<b>50</b>	<b>20</b>	<b>100</b>
<b>II</b>	<b>Practical</b>	<b>50</b>	<b>20</b>	

**Course Content**

**Part A: X-Ray Diffraction Technique**

**Unit-I**

Introduction of Course, Crystal Structure, Single crystal, Polycrystal and amorphous material; Lattice and Basis, Unit Cell, Fundamental Element of Symmetry; Translation, Rotation, Reflection and Inversion symmetry, Introduction of Crystal system and Bravais Lattice in 3 dimensions.

**Unit-II**

Introduction and structure of Simple Cubic lattice(scc), Face centered cubic lattice(fcc) and Body centered cubic structure(bcc); Number of Lattice points per unit cell in scc, fcc and bcc structure. Lattice Planes and Plane Directions, Miller Indices of Planes with examples and tutorials, Method of finding Miller Indices.

**Unit-III**

Nature of X-rays, Production of X-ray, Continuous X-ray Spectrum, Duane and Hunt's Law, Moseley's Law. Principles of X-Ray Diffraction (XRD), Bragg's Law & Inter Planer Spacing.

#### **Unit-IV**

Calculation of Full Width Half Maximum(FWHM), Debye Equation & Particle size determination by X-rays, XRD analysis of Amorphous/ Semi crystalline materials, XRD Analysis of Crystalline Material, Determination of crystal structure.

#### **Unit-V**

##### **(Part B: UV Data Analysis)**

Preparation of samples, Acquisition of Data, Importing of data in to the Mathematica environment, Determination of Spectroscopic Transition, Determination of Band Energy Gap.

#### **References:**

1. Solid State Physics by Puri and Babbar, S. Chand Company Limited, New Delhi, ISBN No.: 9788121914765, 2008.
2. X-Ray Diffraction: A Practical Approach by C. Suryanarayana, Springer Science+Business Media, LLC, ISBN No.: 9781489901484, 1998.
3. Instrumental Methods of Analysis by H.H. Willard, L.L. Merritt, J.A. Dean and F.A. Settle, ACS Publication.
4. Introduction to Molecular Spectroscopy by C.N. Banwell, Mc Graw Hill.