

| Course No                 | Course Name   | L-T-P-Credits   |
|---------------------------|---|-----------------|
| <b>CY 541</b>             | <b>Crystallography</b>  | <b>3-0-0: 3</b> |
| Prerequisite: NIL         |   |                 |
| <b>Course Objectives:</b> | The main objective of this course is to provide basic foundation on the concepts of space group, crystal and various diffraction methods of structure elucidation. This course is also designed to provide an overview of the basics of diffraction techniques.   |                 |
| <b>Course Outcomes:</b>   | After successful completion of the course, students will be able to: <ol style="list-style-type: none"> <li>1. Understand the basic concepts of symmetry elements and operations.</li> <li>2. Understand crystallographic point group and space group.</li> <li>3. Understand the laws related to diffraction by crystal lattice.</li> <li>4. Understand basics of X-ray diffraction techniques and methods.</li> <li>5. Understand the basic concepts of other diffraction techniques such as neutron and electron diffraction and their applications.</li> </ol>  |                 |
| <b>SYLLABUS</b>           |   |                 |
| Module                    | Contents  | Hours           |
| I                         | <b>Introduction</b><br>Concept of symmetry elements, crystallographic point groups, space group symmetry elements, isogonal symmetry groups, space groups, crystal lattice, Miller indices, reciprocal lattice, Brillouin zone. Diffraction by lattice, Bragg's Law, X-rays: Origin, generation, absorption, filtering and detectors, and synchrotron radiations.   | <b>12</b>       |
| II                        | <b>Molecular and Crystal Structure Determination</b><br>Experimental methods of X-ray diffraction; Laue method and Debye-Scherrer method. Primitive and nonprimitive unit cells. Indexing of reflections. Identification of unit cells from systematic absences in diffraction pattern. Structure factor and its relation to intensity and electron density, structure analysis, Patterson and direct methods of structure solution.<br>Neutron diffraction: Production and detection of neutrons, neutron scattering factors, features of neutron diffraction, applications of neutron diffraction techniques.<br>Electron diffraction: Production and detection of electrons, electron scattering factors, features of electron diffraction, applications of electron diffraction techniques. | <b>24</b>       |

**Essential Readings:**

1. C. Giacavazzo, "Fundamentals of Crystallography", Oxford University Press, 1<sup>st</sup> Edition, 1992.

**Supplementary Readings:**

1. G. H. Stout and L. H. Jensen, "X-ray structure determination: A practical guide", Wiley-Blackwell, 2<sup>nd</sup> Edition, 1989.

