

MSE-231 X Ray Diffraction and Crystallography

Credit Hours: 3-0

Pre-requisites: MSE101-Fundamentals of Engineering Materials

Course Objectives

The course is designed to introduce x-ray diffraction as a tool for materials characterization. The specific course objectives are:

- Electromagnetic radiation, Continuous/Characteristic spectrum, Absorption
- Types of lattices, Miller notation, Symmetry operators, Stereographic projection
- Bragg's law, Diffraction methods
- X-ray scattering (electron, atom, unit cell), structure/multiplicity factor, Examples
- Phase identification by x ray diffraction
- Crystal structure determination, Indexing

Course Contents

Introduction to X-rays and their engineering utility.

Production, absorption and filtration of X-rays.

Introduction to crystal systems, crystal symmetry, Bravais lattices, primitive and non-primitive cells.

Designation of points, lines and planes, directions, Miller indices, crystal structures of common metals and ceramics, defects, stereographic projection.

Bragg's law, Laue's equations, diffraction directions, x-ray spectroscopy, diffraction methods, factors affecting the relative intensity of diffraction lines, intensity calculations.

Phase identification, determination of crystal structure, indexing patterns of cubic and non-cubic crystals, displacement disorder, mixed crystals and substitution disorders, small angle X-ray scattering:

Course Outcome

At the end of the course the students are expected to have learned the following:

- Usage of x rays in crystallography

- Diffraction methods and applications in materials characterization
- Phase identification and crystal structure determination

Suggested Books

- B.D. Cullity, S.R. Stock, and Stuart Stock, *Elements of X-Ray Diffraction (3rd Edition)*, Addison Wesley Series in Materials Engineering
- Guinier *X-Ray Diffraction: In Crystals, Imperfect Crystals, and Amorphous Bodies*, W. H. Freeman and Company
- E. Warren, *X Ray Diffraction*, Addison-Wesley series in metallurgy and materials engineering