THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Structure and Characterization of Materials

MATSCEN 2241

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Course Components:

Lecture

Course Description:

Atomic structure of materials and its determination using X-ray diffraction techniques. Introduction crystalline defects and microstructure. Characterizing and quantifying materials microstructure using optical and electron microscopy.

Prerequisites and Co-requisites:

Prereq: 2010, Physics 1250 or 1260, Math 1151 or 1161, and Chem 1210 or 1250; and enrollment as MatScEn-BS student; or permission of instructor.

Course Goals / Objectives:

- Relationship to MSE Program Outcomes: Applies basic science and engineering concepts to develop a fundamental understanding of atomic structure, defects and microstructural features in materials
- Students are presented with the basic operation and capabilities of the principal characterization methods used in materials science, namely XRD, optical microscopy and SEM
- Understand how microstructure and crystalline defects affect the properties of materials, and how these features can be characterized?concepts that are fundamental for graduate research and employment in the area of materials design

Course Topics:

- Atomic Structure of Materials Common structures for metals, semiconductors ceramics and polymers -Defining directions and planes - Anisotropy and effect on properties - Point defects - Amorphous materials and examples
- Introduction to X-Ray and Electron Diffraction X-ray and electron sources Bragg's law Atomic scattering factor and structure factor Phase identification and texture measurement Electron Back-Scattered Diffraction
- Dislocations and Interfaces Basics of dislocation structure Energy and forces associated with dislocations -Structure and energy of surfaces and grain boundaries - Structure of interphase boundaries - Connections to macroscopic properties
- Optical and Scanning Electron Microscopy Instrumentation Types of signals Imaging in the OM and the SEM - Resolution, aberrations, depth of field - Comparison of SEM and optical microscopy - Live/remote demo using the Phenom or Quanta
- Stereology and Quantitative Image Analysis Need for stereology and quantitative microscopy -Measurement of key microstructural features - Statistics in stereology
- Energy Dispersive Spectroscopy Basics, need for compositional analysis Principles of compositional analysis Capabilities, limitations Resolution and uncertainty
- Spectroscopy Using Photon and Ion Probes Photon interactions with matter Raman, IR, UV and Optical Spectroscopy Ion interactions with matter Rutherford Backscattering Spectroscopy Secondary Ion Mass Spectroscopy

Designation:

Required