ESM 325 Diffraction Techniques & Structure of Solids (Elective)

Course Catalog description:

X-ray diffraction techniques are emphasized. Topics include coherent and incoherent scattering of radiation, structure of crystalline and amorphous solids, stereographic projection, and crystal orientation determination. The concept of reciprocal vector space is introduced early in the course and is used as a means of interpreting diffraction patterns. Laboratory work in X-ray diffraction patterns is also included to illustrate the methods.
3 credits

Pre- or Corequisite(s): ESG332 Materials Science I: Structure and Properties of Materials

Text(s) or other required material:

Leonid V. Azaroff, Elements of X-Ray Crystallography, 1990, CBLS Pub., ISBN: 1878907115

Course learning outcomes:

The following skills are attained by students taking this class:

an ability to apply knowledge of mathematics, science and engineering
an ability to design and conduct experiments, as well as to analyze and interpret data
an ability to function on multi-disciplinary teams
an ability to identify, formulate, and solve engineering problems
an understanding of professional and ethical responsibility
an ability to communicate effectively
the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Topics Covered:
Weeks 1 &2. Description of nature and properties of X-rays: Production of X-rays, X-ray sources: Detection of X-rays.
Weeks 3 & 4. Elementary theory of diffraction;- Analysis of directions of diffracted beams - Bragg approach and Von Laue approach.
Weeks 5 & 6. Elementary Crystallography;- Symmetry Elements, Point Groups, Space Groups, Vector Analysis in Non-Orthogonal Systems, Theory of Matrix Transformation Between Lattices.
Weeks 7 & 8. Experimental methods: Powder Technique, Laue method, Use of Diffractometer.
Weeks 9 & 10. Intensities of diffracted beams: Scattering from single electron, atom, unit cell, small crystal - the kinematical theory of x-ray diffraction.
Weeks 11 & 12. Analysis of assumptions and validity of the kinematical theory - the dynamical theory of x-ray diffraction.
Weeks 13 & 14. X-ray topography.

Class/ Laboratory Schedule:

ESM	325	Diffr Tech & Structr of Solids	LEC	1	TUTH	9:50 AM	11:10 AM

Contribution of Course to meet requirement of Criterion 5:

For contribution of course to Program Outcomes see above and below. Regarding Program Objectives, the course makes incremental contributions to the attainment of all 5 Objectives (see below).

(1) Conducting successful careers in engineering or science-related disciplines, by recognizing and responding to emerging markets and technologies or completing graduate studies in top ranked institutions;

(2) Contributing to the development of globally competitive economies on a regional and/or national scale;

(3) Leading interdisciplinary research, design, and/or policy-making teams in government, academic or industrial settings;

(4) Engaging in 'lifelong learning' activities, including professional society membership and support, conference attendance, presentations or organization, and knowledge-transfer or community-based outreach activities in their organizations; and

(5) Conducting themselves in the engineering professions in a manner which holds paramount the importance of public health, safety and welfare, as well as their own ethical responsibilities.

Relationship of course to program outcomes:

The following outcomes are partially satisfied by this class:

an ability to apply knowledge of mathematics, science and engineering
an ability to design and conduct experiments, as well as to analyze and interpret data
an ability to identify, formulate, and solve engineering problems
an understanding of professional and ethical responsibility
an ability to communicate effectively
the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context
an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Person(s) who prepared this description and date of preparation: