MSE 489 – Transmission Electron Microscopy of Materials

__ Required _X_ Elective

Catalog Description: MSE 489: Transmission Electron Microscopy of Materials (3 Units) Transmission electron microscopy in materials characterization. Specimen preparation; instrumental techniques; interpretation of micrographs and diffraction patterns, micro- and nano-analysis in transmission electron microscopy. May be convened with MSE 589.

Prerequisites By Topic: Basics Materials science and engineering.

Textbooks: Transmission Electron Microscopy: A Textbook for Materials Science. Second Edition, D. B. Williams & C. B. Carter, Springer, 2009

Course Objectives:

1. To understand the concepts, instrumentation, and applications of TEM, high-resolution TEM, and X-ray microanalysis.
2. To obtain working knowledge in these subjects as well as the basic sample preparation techniques and the general maintenance of the TEM laboratories.
3. To obtain hands-on experience with the equipment and analysis of TEM images, diffraction patterns and X-ray spectra.

Topics Covered: (about 2 Class hours for each topic)

1. Introduction
2. Scattering & Diffraction
3. Elastic Scattering
4. Inelastic Scattering & Beam Damage
5. Diffraction in TEM
6. Thinking in Reciprocal Space
7. Diffracted Beams and Bloch Waves
8. Diffraction from Crystals
9. Diffraction from Small Volumes
10. Amplitude Contrast
11. Phase Contrast
12. Imaging and Bending Effect
13. Planar Defects
14. Imaging Strain Fields
15. Weak-Beam Dark-Field Microscopy
16. High-Resolution TEM
17. X-ray Spectrometry
18. X-ray Spectra and Images

Class Schedule:

1. Two lecture sessions per week.
2. Three hours laboratory session per week
3. Seven laboratory reports
4. Two open-booked examinations

Computer Usage:

Students are required to prepare their laboratory reports using word processors. They are also look up information for image and diffraction analysis on-line.

Laboratory Sessions:

Introduction to microscope components; Alignment, Focus Correction Astigmatism; Through Focus Series; Diffraction Patterns and Kikuchi Patterns; Bright Field and Dark Field Imaging; High Resolution Imaging: Silicon Lattice and Carbon Nanotubes; X-Ray Acquisition

Contribution to Professional Component:

____% Math & Basic Sci.	____credits Math & Basic Sci.	
100 % Engr. Science	3 credits Engr. Topics	
____% Engr. Design		

Relationship toProgram Outcomes:

Level of Activity (High, Medium, or Low)	PROGRAM OUTCOMES - To produce graduates who can:
H	apply the fundamentals of mathematics, the physical and/or life sciences, and engineering principles.
L	apply the fundamentals of materials science and engineering, the interrelationship among processing, microstructure, properties, and performance, and can apply that knowledge in solving problems.
M	work individually and in teams in order to define alternative solutions from diverse knowledge bases and implement an acceptable solution in a local, national or global context.
H	communicate effectively in verbal presentations, written reports and other media.
H	utilize modern engineering tools used in the profession.
H	use resources such as library facilities, the internet, data bases, professional society offerings, etc., as part of life-long learning.
	value life-long learning and can put into action their responsibilities to the profession and society.

Person preparing syllabus **Supapan Seraphin**