MSE 6110 – Transmission Electron Microscopy

Spring SEMESTER 2020

Instructor: Josh Kacher
Office: 282 Love Building
Telephone: 404-894-2781
E-mail: josh.kacher@mse.gatech.edu
Office hours: Tuesday 9:30-10:30 am
Wednesday 12:30-1:30 pm
Or email and set up a time

TA:

Textbook: Primary textbook will be Transmission Electron Microscopy, by D. B. Williams and C.B. Carter
Additional textbooks that may be useful:

Physical Principles of Electron Microscopy, R.F. Egerton, Springer, 2010

Transmission Electron Microscopy and Diffractometry of Materials, B. Fultz and J.M. Howe, Springer 2008

(free electronic copies available through GT from www.springer.com)

Final Exam: No final exam

Grading: The following components will make up your final grade.

Weekly quiz	25%
Homework	10%
Class project	40%
Midterm exam	25%

Assignments/quizzes:
Problem sets will be assigned periodically over the course of the semester. Assignments will be made at least one week prior to the due date.

Quizzes will be held weekly at the beginning of class on Wednesdays. The quizzes will be projected on the overhead and completed on paper. Each student is required to bring paper and a writing utensil to class on Wednesdays. Lowest quiz score will be dropped. Any missed quizzes will count as a zero on your grade unless excused ahead of time. *Every quiz will include the question, "did you do the reading this week?".*

Grading Scheme:
A 90-100 B 80- 89.9 C 70-79.9 D 60-69.9

Learning Outcomes:
By the end of the course, the student should have an understanding of the basic components which make up a transmission electron microscope as well as a fundamental understanding of the theory behind electron scattering and different imaging modes. The student will have a theoretical knowledge of how to conduct basic characterization of materials, including their atomic structure and defect state, with some hands on experience.

Topics Covered:

1. Basic principles of electron interactions with atoms
2. TEM hardware
3. Specimen preparation
4. Electron diffraction
5. TEM imaging (bright-field, dark-field, phase contrast, STEM)
6. Contrast analysis of defects

Tentative lecture schedule (*dates will almost definitely change!!!)*

Lecture	Date	Topic	Reading (W&C)	Assignment due
1	1/9	Introduction, scattering and diffraction basics	1, Ruska lecture	
2	1/11	Introduction, scattering and diffraction basics	2,3,4	Read lecture, take picture of TEM, list of functional TEMs on campus
	1/16	MLK Day		
3	1/18	Scattering and diffraction basics	2,3,4	
4	1/23	Scattering and diffraction basics	2,3,4	Project proposal due
5	2/1	The TEM	5-9	
6	2/6	The TEM	5-9	
7	2/8	Electron diffraction	11-12	Sample prep progress report due
8	2/13	Electron diffraction	13, 16	
9	2/15	Electron diffraction	17-19	
10	2/20	Electron diffraction	20-21	
11	2/22	BF/DF/WBDF imaging	22, 23, 26	
12	2/27	Contrast analysis of defects		
13	3/1	Contrast analysis of defects	22, 23, 26	
14	3/6	Exam review		
15	3/8			Midterm Exam
16	3/13	Phase contrast	27-28	
	3/20	Image simulation	27-28	User facility outline due
	3/22	Spring Break		
17	3/27	Spring Break		
18	3/29	Image simulation	30	
19	4/3	STEM/ Aberration correction	27-28	
20	4/5	STEM/ Aberration correction	27-28	User facility proposal due
21	4/10	X-ray analysis	32-36	
22	4/12	X-ray analysis	32-36	
23	4/17	EELS	37-39	

24	4/19	Presentations		
25	4/24	Presentations		

Missed Tests: ***Unexcused*** – A grade of zero will be given for all unexcused missed tests.

Excused – Student must contact instructor ***before*** a test is missed. Exceptions may be made in special circumstances.

Canvas: Homework will be assigned in class and posted on canvas.

Homework: Homework can be done in groups but each student must submit their own work.

Tests and Exams: All quizzes and exams will be closed book and notes, but some equations and tables will be provided as needed. However, **basic equations will not be provided.** This will be clarified as material is covered.

Academic Honor Code:

Compliance with Georgia Tech's Academic Honor Code is required.

Please read and understand this document (if you have not already done so). Per the Georgia Tech Honor Code Website
http://honor.gatech.edu/content/2/the-honor-code

Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source."If caught plagiarizing, you will be dealt with according to the GT Academic Honor Code.

For appointments, please come by during office hours or email to arrange a different time.