Course Syllabus: BIOL 4450/6450: Fall 2013

Theory and Practice of Scanning Electron Microscopy

CRN 81304 **and** 81325**; MW 1:00 – 1:50 p.m. (BC 1202), MW 2:00 – 3:50 p.m. (BC 1075)**

Instructor: Dr. Russ Goddard, BC 2090, 249-2642
email: rgoddard@valdosta.edu **Office Hours**: Mon. and Wed. 10:15 a.m. – noon.

Course Catalog Description: BIOL 4450/6450, Theory and practice of scanning electron microscopy, 2-2-4. Prerequisite: BIOL 3200 and 3250 or consent of the instructor (**for 6450**: admission into the graduate program). General principles of scanning electron microscopy operation and theory with comparison to light optics in a laboratory intensive environment. Topics include fixation and preparation of samples for standard, low voltage, low vacuum, and high resolution SEM.

Recommended Texts:

Goldstein et. al. 2003. Scanning electron microscopy and x-ray microanalysis, 3e. Kluwer Academic/ Plenum Publishers. New York.

Scanning Electon Microscopy Primer: http://www.charfac.umn.edu/instruments/sem_primer.pdf.

Grading: There are two parts to this course, the lecture and the laboratory, but students must understand that this course is a laboratory intensive course and that they will need to spend significant independent time in the laboratory.

Lecture Exams (300 pts): There will be 3 one-hour exams in this course. Each exam will cover approximately 1/3 of the lecture and reading material. Each of the three exams will be worth 100 pts.

Lab Image Portfolio (200 pts.): Throughout the course, students will be assigned comparative parameters that they will use to photograph specimens. Students will be required to make a high resolution print portfolio of the comparative images before the end of class.

Research projects:

BIOL 4450 and 6450 (50 pts): Since the SEM represents a tool for acquiring high quality research data, students must propose a research topic that could be studied using the equipment and procedures learned in the course. Students will research the literature and take preliminary photographs of any specimens that fit into a scientifically valid study. Students will give either a 10 min PowerPoint presentation, or present a poster, on their proposal at the end of the course. Graduate students in BIOL 6450 will present their proposals before midterm.

BIOL 6450 (100 pts): Graduate students are expected to propose a research topic early in the course to study (see previous assignment) and will develop this proposal into a research paper using original image data obtained using the instrumentation in this course. A research paper with significant literature review (citations) and original data will be submitted (75 pts) and a 30 min research presentation (25 pts.) using PowerPoint will be given to the class at the end of the course.

Oral Proficiency Exams (100 pts): Each student will orally articulate and demonstrate all procedures with specimen preparation and microscope use, following a standard checkout procedure in use in the microscopy lab. Oral checkouts will be performed several times during the semester to check basic operation and knowledge of more specific procedures as they are addressed in class. Before students can operate the SEM independently, they must pass the standard checkout procedure.

Attendance: Students who miss class (lecture or laboratory) will lose points toward their final grade. Don't miss class.

The final grades will be based on a percentage of your cumulative points relative to the total points possible:

Guaranteed grade distribution is as follows (Max. pts = 650 for BIOL 4450; 750 for BIOL 6450):

A = 90-100%
B = 80-89%
C = 70-79%
D = 60-69%
F = ≤ 59%

Points available: **BIOL 4450**:

Lecture Exams:	300 pts
Research Proposal:	50
Oral Proficiency Exam:	100
Lab Image Portfolio:	200
Total:	650 pts

Points available: **BIOL 6450**:

Lecture Exams:	300 pts
Research Proposal:	50
Research Paper / Oral Presentation:	100
Oral Proficiency Exam:	100
Lab Image Portfolio:	200
Total:	750 pts

Tentative EXAM SCHEDULE:

Exam 1: Monday, 16 September 2013
Exam 2: Monday, 21 October 2013
Exam 3: Monday, 2 December 2013

Final Exam Period: **Wednesday, Dec. 4, 2013;** 12:30 pm - 2:30 pm (Final Project Presentations).

FERPA: The Family Educational Rights and Privacy Act (FERPA) prohibits the posting of grades by social security number or in any manner personally identifiable to the individual student. Grades will not be posted by social security number or by name. No grades can be given over the telephone, as positive identification cannot be made by this manner.

Students with Disabilities: Students requesting classroom accommodations or modifications because of a documented disability should contact the Access Office for Students with Disabilities located in room 1115 Nevins Hall. The phone numbers are 245-2498 (voice) and 219-1348 (tty).

It is expected that both the students and instructor will abide by the University policy on academic integrity found in the Student Code of Conduct on Page 60 of the student handbook:
(http://www.valdosta.edu/studentaffairs/documents/SAF_Student_Handbook_02122010revision.pdf)

General Course Objectives [Relevance to University General Education Outcomes listed as ***VSU#***, for Biology undergraduate educational outcomes as ***BIOL #***, and for Biology Masters educational outcomes as ***MS #***]**:**

At the end of the course, each student will be able to:

1. Operate all instruments pertaining to SEM preparation (CPD, Sputter Coater, etc.) [VSU #3, BIOL #1, MS #1]
2. Operate the SEM proficiently and safely in all modes of operation. [VSU #3, BIOL #1, MS #1]
3. Analyze elemental characteristics of various samples [VSU #3, BIOL #1, MS #1]
4. Use image analysis software to make simple measurements of digital images. [VSU #7, BIOL #1, MS #1]
5. Understand what types of samples are amenable to SEM examination under different modes of operation. [VSU #5, BIOL #3, MS #1]
6. Identify the basic types of data that the SEM can produce and how that data can be interpreted and analyzed. [VSU #7, BIOL #1, MS #1]
7. Identify topical content standards that can be addressed with an SEM study. [VSU #5, BIOL #1& 3, MS #1]
8. Additional for Graduate Course 6450:
    - Develop a good scientific question that leads naturally to a good experimental design that is carried through to a written paper in the format of a scientific journal. [MS #2]
9. Present image data in a written portfolio of required images generated throughout the course. [VSU #7, BIOL #1, MS #2]
10. Present an oral PowerPoint presentation to the class of a research proposal to study a biological problem with SEM. [VSU #4&7, BIOL #1, MS #1&2

Tentative Lecture and Laboratory Schedule:

		Lecture:		Laboratory:
Week	**Date:**	***Topic :***	**Day**	**Exercise**
1.	Aug. 12	Introduction and history of microscopy, Biological Specimen Preparation, Fixation	Aug. 12	No Lab
			Aug. 14	Safety in the Microscopy Laboratory, Fixation and preparation of specimens for SEM
2.	Aug. 19	Applications of LM, TEM, and SEM, Illumination sources (photons vs. accelerated electrons), Lens systems	Aug. 19	Fixation and preparation of specimens for SEM
			Aug. 21	Critical Point Dryer principles and operation, Operation of the Denton Desk V sputter coater.
3.	Aug. 26	Magnification vs. resolution; Specimen-electron beam interactions; Factors affecting resolution and contrast	Aug. 26	Basic Operation of the SEM (Part 1): Cold vs. Warm start principles, Specimen exchange, turning on the microscope;
			Aug. 28	" – second half of class.
4.	**Sept. 2**	**Labor Day No Classes**	Sept. 2	Basic Operation of the SEM (Part 2): Selection of Accelerating Voltage, Spot size, mechanical stage controls
	Sept. 4	Electron Guns, Lenses, vacuum systems, SEM Modes of Operation	Sept. 4	" – second half of class.
5.	Sept. 9	Illumination Systems and Aberrations, Magnification, Resolution, and Depth of Field	Sept. 9	Basic Operation of the SEM (Part 3): Optimization of resolution, depth of field, and signal to noise ratios.
			Sept. 11	" – second half of class.
6.	**Sept. 16**	**Exam 1**	Sept. 16	Independent Use and Practice
	Sept. 18	SEM Imaging Processes SEM Signal Detectors	Sept. 18	Independent Use and Practice
7.	Sept. 23	SEM Contrast Formation and Image Quality Other Contrast Mechanisms	**Sept. 23**	**Basic Checkout Lab Exams**
			Sept. 25	**Grad Student Research Proposals Due**
8.	Sept. 30	High Resolution Imaging and Signal Processing	Sept. 30	Advanced Operation: Selection of Detectors for different sample composition
	Oct. 3	MIDTERM Date: Last day to drop without penalty	Oct. 2	" – second half of class.
9.	Oct. 7	Stereomicroscopy	Oct. 7	Advanced Operation: Low Voltage SEM & Low Vacuum SEM
			Oct. 9	" – second half of class.
10.	Oct. 14	TBA	Oct. 14	Advanced Operation: Energy Dispersive X-ray analysis
			Oct. 16	" – second half of class.
11.	**Oct. 21**	**Exam 2**	Oct. 21	Advanced Operation: Energy Dispersive X-ray analysis
	Oct. 23	Microscopy of Non-Conducting Specimens	Oct. 23	" – second half of class.
12.	Oct. 28	Variable Pressure SEM and Environmental SEM.	Oct. 28	Independent Use and Practice
			Oct. 30	Independent Use and Practice
13.	Nov. 4	Low Voltage Microscopy	Nov. 4	Image Artifacts; Measuring Image data with ImageSys.; Photoshop and maintenance of image data
			Nov. 6	
14.	**Nov. 11**	High-Resolution Microscopy methods	**Nov. 11**	**Final Checkout / Oral exams**
			Nov. 13	**Final Checkout / Oral exams**
15.	Nov. 18	Analytical SEM: Qualitative X-ray Analysis with EDS and WDS	Nov. 18	Final Preparation of Portfolio's
			Nov. 20	Final Preparation of Portfolio's
16.	Nov. 25	THANKSGIVING HOLIDAYS		
	Dec. 2	**Exam 3 (Last Class Day)**		
17.	**Dec. 4**	**Final Exam Period 12:30 – 2:30 pm**		**Projects Due; Presentations in Lecture Room**