Applied Microscopy in Research; CHM 483 BSC 482 GLY 483 4.0 credit hours Spring 2009
MWF 10-10:50 107 BBSC, Lab to be arranged
Course description: This course consists of 2 parts; 1- an introduction to the theory of operation of light, electron and scanning probe microscopes 2-application of imaging systems/instrumentation to a student research project. This course is intended to give students a hands-on research experience and a general familiarity with research microscopy. Enrollment in this course requires instructor permission (based on evaluation of student preparation and viability of student project).

Faculty:
Dr. Mike Norton (S-478), 304-696-6627, norton@marshall.edu, meeting by arrangement
Non-faculty lecture/lab:
David Neff (BTSC-107), 304-696-3569, dneff@marshall.edu, office hours MWF 8:30-9:30 and by arrangement

Texts:
-Fundamentals of Light Microscopy and Electronic Imaging Author: Douglas B. Murphy, ©2001 Wiley-Liss publishers ISBN 0-471-25391-X
-Scanning Electron Microscopy and X-ray Microanalysis, 3rd Edition Authors: J. I. Goldstein, D. E. Newbury, D. C. Joy, L.C. Sawyer, E. Lifshin, C.E.Lyman, P. Echlin, J.R. Michael © 2003 Springer publishers ISBN 0-306-47292-9
Course lectures will be posted on line. http://www.science.marshall.edu/dneff/
Supplemental for fluorescence microscopy (for student benefit)
http://www.olympusmicro.com/primer/techniques/fluorescence/fluorhome.html
Computer requirements: Student projects will be completed either on MU computers or on student's personal computer. All software/hardware resources will be provided in room 107 BBSC.

Upon completion of this course, students will be:	**Each student learning outcome will be assessed in the following manner:**
Able to discuss and apply theoretical and practical knowledge of electron, atomic force and light microscopy.	These outcomes will be assessed with attendance record, quizzes, exams, and formal lab reports.
Able to work hands on with a variety of imaging and spectroscopic instrumentation.	Student activity during lab sessions, quality of lab reports and quality of data acquired in fulfillment of project requirement.
Able to produce a high quality (suitable for presentation at a professional meeting) research report including literature review, background, methods and results/discussion.	Student projects will be evaluated at 4 different time points and will be delivered in final form at SigmaXi research day.

Lecture: MWF 10:00-10:50 BBSC room 107. Lecture attendance is required during entire semester and will be considered in grading as described below. **Marshall's official policy regarding excused absences can be found on pp. 128-130 of the 2008-2009 undergraduate online catalog, which can be accessed at http://www.marshall.edu/catalog/undergraduate/ug_08-09_published.pdf)**. Makeup exams and quizzes will be given in case of excused absences.

Lab: The first 6-7 weekly lab meetings will be arranged by us and by consensus at first class meeting. Following these group meetings, lab time will be arranged by students, please schedule at least 2 hours collection and processing of image data (for your project) per week on appropriate instrumentation; this is in addition to lecture periods.
Lab reports for weeks 1-6 should include sections titled; **introduction/goals**, **instrumentation/materials & methods**, **results/discussion.** These lab reports must include a micrograph with a descriptive figure legend and scale information. Lab reports should also include a diagram or drawing (sometimes, a picture is worth a thousand words and a better grade). This diagram/drawing can be hand drawn or computer generated. Lab reports are due the Monday following the lab session.

Grading: undergraduate and graduate credit:
Project 60%: project idea introductory presentation (including literature review); 5% lit. review, 5% presentation
scheduled weekly instrument usage; 5% hours worked, 5% competence and caution
scheduled progress reports; 5% abstract, 5% materials and methods presentation
SigmaXi research day report layout 5% completeness and care on poster, 5% web page design
SigmaXi research day report content 5% design, 5% experimental efforts, 10% results and conclusions
(RESULTS DO NOT HAVE TO SUPPORT YOUR HYPOTHESIS FOR GOOD REPORT AND FULL CREDIT)

Non-project 40%: midterm exam; 10%, final exam; 5%, quizzes; 5%, attendance; 5%, lab reports and participation; 15% (2-3% per lab)

Schedule:

week of 1/12/2009 lab: intro. to computer station software/hardware and digital image information.
lecture: introduction to course, introduction to instrumentation and basic terminology, lab schedule setup, introduction to microscopic techniques and instrumentation at Marshall U, brief history of microscopy.
read: Goldstein1 & 2 (selected)

1/19 MLK day, no classes Monday
week of 1/19 lab: SEM basic imaging skills / SEM beam parameters.
read: project database searche, literature review
lecture: student project discussion, **student presentation of project ideas** (15 min. max/student with discussion, have at least one reference with hard copy for instructor)

week of 1/26 lab: SEM beam parameters / SEM image quality and contrast.
read: Goldstein 3,4 (selected), Murphy1, 2,3,4(selected)
lecture: specimen labels & contrast, probe /specimen interactions in light micr., EM, fluorescence CSLM, and AFM

week of 2/2 lab: EDS (x-ray spectroscopy with SEM)
read: Goldstein 6&7 (selected)
lecture: microscope probe formation and control SEM & CSLM, and AFM

week of 2/9 lab:transmitted and fluorescence light microscopy and CSLM, basic confocal technique
read: Murphy 5&6 (selected) Murphy 11&12
lecture: image formation AFM, SEM, CSLM, and the eye, resolution (in space, time and energy)

week of 2/16 lab: CSLM optimize and process images
lecture: top down overview of SEM, CSLM, and AFM

week of 2/23 lab: atomic force microscopy on PacificNanotecnology NanoR
lecture: Review & 2 day M**idterm exam** (exam will be on Wednesday & Friday, it covers reading, lecture and labs)

week of 3/2 lab: begin student projects, **instrument scheduling by students**
lecture: Student projects; introduction, materials and methods

week of 3/9 lab: student projects, **instrument scheduling by students**
lecture: Student projects; progress, problems and preliminary results, **Student presentations; introduction, materials and methods** (powerpoint style presentation, 15 min. max/student)

week of 3/16 lab: student projects, **instrument scheduling by students**
lecture: Student projects; progress, problems and results & Dr. Wang, intro. to TEM
1st draft of project abstracts due

Week of 3/23: spring break 2009

week of 3/30 lab: student projects, **instrument scheduling by students**
lecture: Student projects.

week of 4/6 lab: student projects, **instrument scheduling by students**
lecture: student web page preparation (by guest from MU IT dept.) Student projects; results and discussion,

week of 4/13 lab: student projects**-final week for data collection and analysis**
lecture Student projects; results and discussion **final draft abstract due**

week of 4/20 lab: class projects, **posters must be ready to print**
lecture: **Student presentations, practice poster presentations**

week of 4/27 Sigma Xi research day week (troubleshoot and hang posters, web page preparation)
lecture: final preparation and practice for presentations, web page preparation
5/1 **Sigma Xi research day, all must be present with posters during event** (this date is tentative)

week of 5/4: **web page due, final exam 10:15-12:15 Monday May 4th**

GENERAL UNIVERSITY INFORMATION

Statement of nondiscrimination: MU is an equal opportunity/affirmative action institution, and maintains a grievance procedure incorporating due process available to any person who believes he or she has been discriminated against. At all times, it is your right to address inquiries or concerns about possible discrimination to the Equal Opportunity Officer, Office of Human Resources. Concerns about discrimination can also be brought directly to your instructor's attention, and/or to the attention of your instructor's Department Chairman.

See below for MU links.

Disabled services: http://www.marshall.edu/disabled/

Academic Dishonesty Policy: All students should be familiar with the university's policy concerning academic dishonesty. This policy can be found on pp. 106 – 109 of the undergraduate catalog http://www.marshall.edu/catalog/undergraduate/ug_08-09_published.pdf, or on pp. 59 – 62 in the 2008 online graduate catalog http://www.marshall.edu/catalog/Graduate/S2008/gr_sp08.pdf.

Computing use policy: http://www.marshall.edu/ucs/CS/accptuse.asp

Other MU policy: http://musom.marshall.edu/students/policies/ http://www.marshall.edu/assessment/Syllabus%20Information/University_Policies.doc.

Inclement Weather Policy: Students can find information concerning Marshall's policy regarding inclement weather on pp. 95-96 of the 2008-2009 undergraduate online catalog http://www.marshall.edu/catalog/undergraduate/ug_08-09_published.pdf, or on pp. 23-24 of the 2008 graduate catalog http://www.marshall.edu/catalog/Graduate/S2008/gr_sp08.pdf.

Bibliography:

Scanning electron microscopy and x-ray microanalysis. Joseph I. Goldstein [et al.]
New York : Kluwer Academic/Plenum Publishers, c2003 3rd ed

Electronic light microscopy : the principles and practice of video-enhanced contrast, digital intensified fluorescence, and confocal scanning light microscopy. edited by David Shotton
New York : Wiley-Liss, c1993

Light and electron microscopy. Slayter, Elizabeth M
Cambridge [England] ; New York : Cambridge University Press, c1993

Handbook of fluorescent probes and research chemicals. Haugland, Richard P, Michelle T.Z. Spence, editor, Iain D. Johnson, technical information coordinator
Eugene, OR, USA (4849 Pitchford Ave., Eugene 97402) : Molecular Probes, c1996

Handbook of biological confocal microscopy. editor, James B. Pawley
New York : Springer, c2006 3rd ed

Fundamentals of light microscopy and electronic imaging. Murphy, Douglas B
New York : Wiley-Liss, c2001

Scanning electron microscopy, X-ray microanalysis, and analytical electron microscopy : a laboratory workbook . Charles E. Lyman, Goldstein, Joseph [et al.]
New York : Plenum Press, c1990

Laboratory methods in histotechnology. edited by: Edna B. Prophet [et al.] ; prepared by the Armed Forces Institute of Pathology, Washington, D.C.
American Registry of Pathology, c1994

Chemistry: the central science. Theodore L. Brown [et al.]:
Upper Saddle River, NJ : Pearson Prentice Hall, c2009 11th ed.

College physics. Paul A. Tipler
New York, NY : Worth Publishers, c1987

Basic histology : text & atlas. Luiz Carlos Junqueira, José Carneiro

New York, N.Y. : McGraw-Hill, c2005.

Introduction to confocal fluorescence microscopy. Michiel Muller
Bellingham, Wash.: SPIE Press, c2006 2nd ed.

Methods in cellular imaging. edited by Ammasi Periasamy
Oxford ; New York : Published for the American Physiological Society by Oxford University Press, c2001

Live cell imaging : a laboratory manual. edited by Robert D. Goldman, David L. Spector
Cold Spring Harbor, N.Y. : Cold Spring Harbor Laboratory Press, c2005

Lehninger principles of biochemistry. David L. Nelson, Michael M. Cox
New York : W.H. Freeman, c2008 5th ed.

Physical chemistry for the life sciences . Thomas Engel, Gary Drobny, Philip Reid
Upper Saddle River, NJ : Pearson Prentice Hall, c2008

Principles of fluorescence spectroscopy. Joseph R. Lakowicz
New York : Springer, c2006 3rd ed