

Applied Microscopy in Research CHM 678**4.0 credit hours Spring 2018****MWF 10:00a - 10:50am S 405, Lab (~2hr/wk) 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 graduate level, hands-on Imaging research experience and a higher level of familiarity with research microscopy. Enrollment in this course requires instructor permission (based on evaluation of student preparation and viability of student project).

Faculty: Lecture/LabDr. Mike Norton (BBSC-241K), 304-696-3489, norton@marshall.edu, office hours MWF 10:50-12:00 and by arrangement**Lab Instructor:**David Neff (BBSC-107), 304-696-3569, dneff@marshall.edu, meeting by arrangement**Texts:****Fundamentals of Light Microscopy and Electronic Imaging, Second Edition Author: Douglas B. Murphy, ©2013 Wiley-Blackwell publishers ISBN 978-0-471-69214-0****Scanning Electron Microscopy and X-ray Microanalysis, Third Edition Author: Goldstein 2003 Plenum Publishers ISBN 978-0-306-47292-3**Course lectures will be posted on line. <http://www.science.marshall.edu/dneff/>

Supplemental for fluorescence microscopy (for student benefit)

<https://www.leica-microsystems.com/science-lab/step-by-step-guide-to-fluorescence-microscopy/>

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 Research Day or as a formal presentation opportunity in the course..

Lecture: MWF 10:00a - 10:50am Science Room 405. Lecture attendance is required during entire semester and will be considered in grading as described below. Makeup exams and quizzes will be given in case of excused absences. **Marshall's official policy regarding excused absences and all other matters can be found in the Marshall University Policies link:**

http://www.marshall.edu/academic-affairs/?page_id=802

Lab: The first 6-7 weekly lab meetings will be arranged by us and by consensus during the first class meeting. Following this set of group meetings, individual lab time will be arranged by each student, please schedule at least 2 hours for collection and processing of image data (for your project) per week on the 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:

Project* 70%: 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 (see schedule below)
Research Day poster report layout: 5% completeness and care on poster; 5% web page design
Research Day report content: 5% design; 5% experimental effort; 10% results and conclusions
Final paper, prepared in the format of a journal appropriate to the topic, in form ready to submit: 10%

(Note: RESULTS DO NOT HAVE TO SUPPORT YOUR HYPOTHESIS FOR GOOD REPORT AND FULL CREDIT)

Non-project 30%: midterm exam: 5%;, final exam: 5%; new method report (see below**): 5%; lab reports and participation: 15% (2-3% per lab)

* **Project:** Student projects should be well defined and significant literature research should be performed by the end of the second week. Projects are usually supportive of Thesis project and materials/supply costs should be borne by students research mentor. Development and implementation of imaging experiments is anticipated throughout the period of the course, with increasing complexity of experiment design expected during the second half of the course.

**** New Method Report:** Students will be expected to perform comparative, quantitative image analysis of their samples. This will include use of analysis software and possibly instrumental calibration. A) prepare a brief but formal operating procedure so their analytical techniques can be carried out by others doing similar work and B) prepare (deliver and document) a focused presentation (~ 15 minutes, pass/fail) reviewing new applications/developments of a relevant imaging technique.

Schedule: (Anticipated Schedule: Dates may be adjusted for class composition or to conform to Research Day schedule)

week of 1/8/2018 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: Goldstein 1 & 2 (selected)

1/15 MLK day, no classes Monday

week of 1/17 lab: SEM basic imaging skills / SEM beam parameters.

read: project database search, literature review

lecture: student project discussion, **student presentation of project ideas** (15 min. max/student with discussion, have at least two references with hard copies of references and ~1 page proposal for instructor)

week of 1/22 lab: SEM beam parameters / SEM image quality and contrast.

read: Murphy 1, 2,3,4(selected)

lecture: specimen labels & contrast, probe /specimen interactions in light micr., EM, fluorescence CSLM, and AFM

week of 1/29 lab: transmitted and fluorescence light microscopy and CSLM, basic confocal technique

read: Murphy 5&6 (selected)

lecture: image formation AFM, SEM, CSLM, and the eye, resolution (in space, time and energy)

week of 2/5 lab: CSLM for live cell imaging basic confocal technique

read: Murphy 16

lecture: image considerations for live cell imaging

week of 2/12 lab: CSLM optimize and process images

lecture: top down overview of SEM, CSLM, and AFM

week of 2/19 lab: atomic force microscopy on Bruker MM8

lecture: Review & 2 day **Midterm exam** (exam will be on Wednesday & Friday, it covers reading, lecture and labs)

week of 2/26 lab: begin student projects, **instrument scheduling by students**

lecture: Student projects; introduction, materials and methods

week of 3/5 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 3/12: lab: student projects, **instrument scheduling by students**

lecture: Student projects; progress, problems and results

1st draft of project abstracts due

week of 3/19 spring break 2016 no class all week

week of 3/26 lab: student projects, **instrument scheduling by students**

lecture: Student projects.

week of 4/2 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 4/9 lab: student projects-**final week for data collection and analysis**

lecture Student projects; results and discussion **final draft abstract due**

week of 4/16 lab: class projects, **posters must be ready to print**

lecture: **Student presentations, practice poster presentations**

week of 4/23 Research Day Week (troubleshoot and hang posters, web page preparation)

lecture: final preparation and practice for presentations, web page preparation

Research Day, all must be present with posters during event (the date is tentative)

week of 4/30: **web page due (on web and in CD form), final exam 12:45-2:45 Monday April 30th, 2018**