SYLLABUS

NEU 366 L
SPRING 2020

Neuroimaging Laboratory Course

Location: BME 2.512:

Section 1 (53785): Tuesday 1-6 pm

Course Instructors:

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Teaching Assistant:

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Schedule

	Date	General Topic	Assignments	Due (1 pm on the day)
1	Jan 21 (IN)	Introduction to light microscopy		
2	Jan 28 (IN)	Köhler illumination	Quiz 1	
3	Feb 4 (IN)	Image Analysis	Quiz 2	Lab report 1 draft (about Lab 2)
4	Feb 11 (IN)	Limitations of light microscopy	Quiz 3	Revised Lab report 1 Lab 3 summary*
5	Feb 18 (IN)	Contrasting mechanisms	Quiz 4	Lab report 2 draft (about Lab 4)
6	Feb 25 (IN)	Imaging of dynamic processes 1	Quiz 5	Revised Lab report 2 Lab 5 summary*
7	March 3 (HN)	Imaging of dynamic processes 2	Quiz 6	Lab report 3 draft (about Lab 6) Project Proposals
8	March 10 (IN)	Independent Projects		Lab 7 summary*
		Spring break		
9	March 24 (IN)	Independent Projects		
10	March 31 (IN)	Presentations		
11	April 7 (IN,JL)	MRI: Introduction	Quiz 7	Revised Lab report 3
12	April 14 (IN,JL)	MRI: structural	Quiz 8	
13	April 21 (IN,JL)	MRI: Diffusion Tensor Imaging	Quiz 9	
14	April 28 (KH)	Electron microscopy	Quiz 10	Lab report 4 (about Labs 11-13)
15	May 5 (IN)	Last day of class		

Red letters indicate the assignments to be graded.

* Each lab summary is a bonus (extra) credit.

Blue letters indicate the assignments, which are not graded but must be turned in.

- Lab report 1 draft will be used for peer-review. If the draft is not turned in, you cannot turn in the revision.
- If the project proposal is not turned in, you cannot conduct the Independent Project.

Neuroimaging Laboratory Course

General Information:
Light microscopy and fluorescence imaging are powerful techniques that are used extensively in biological sciences. This course will introduce students to the exciting world of microscopy. The goal of this class is to provide students with the conceptual and practical skills to carry out research projects using microscopy and imaging. The emphasis is on microscopy techniques that are commonly used in biological sciences. Topics will include operation of a microscope (alignment, general usage), light-matter interaction (diffraction), image formation (contrasting mechanism, wide-field fluorescence, confocal fluorescence), limitations of microscopy (optical resolution, sampling resolution), image processing (feature extraction), image analysis (stationary image and time-series image), and a survey over different imaging techniques (magnetic resonance imaging, electron microscopy). Students will have the opportunity to design their own research projects and carry out independent research.

Requirements:
NEU 335 with a grade of at least C-.

Class philosophy:
This class is based on the idea of discovery. This class is not designed to carry out experiments by following a step-by-step list. Instead, in each class one or several challenges are to be solved.

Expect to feel “lost” at some point in many classes. This is to be expected and part of the learning experience in this class. The idea is that solving this challenges and overcoming the “lost” feeling provides a more memorable experience, a deeper understanding of the concepts, and a longer retention of the important concepts.

Students are expected to study the laboratory manual for NEU 366L prior to each class. Each microscope rig will have up to 3 students. Students are expected to carry out experiments cooperatively. Discussion between groups is strongly encouraged. To cover wide range of microscopy techniques, multiple faculty members will teach this course.

Flags:
This course carries two flags (Writing and Independent Inquiry). Writing flagged courses provide the opportunity to develop students’ writing skills through substantial writing projects. Independent Inquiry flagged courses are designed to engage students in the process of independent investigation of a question or problem. You should therefore expect a substantial portion of your grade to come from writing, independent investigation, and presentation of your own work (see below for details).

Writing flag: This course carries the Writing Flag. Writing Flag courses are designed to give students experience with writing in an academic discipline. In this class, there will be comprehensive training on writing, instruction on evaluating writing, and tips on improving writing. Feedback will be given from peers and from instructors. You will thus be required to read each other’s lab reports. You will also have the opportunity to revise. A substantial portion of your grade will come from your writing assignments (45 %). Writing Flag classes meet the Core Communications objectives of Critical Thinking, Communication, Teamwork, and Personal Responsibility, established by the Texas Higher Education Coordinating Board.

Independent inquiry: This course carries the Independent Inquiry flag. Independent Inquiry courses are designed to engage you in the process of inquiry over the course of a semester, providing you with the opportunity for independent investigation of a question, problem, or project related to your major. A substantial portion of your grade will come from the independent investigation and presentation of your own work (35%). Specifically, it will come from one of the lab reports (15%) and your “independent project” (20%).

Grading:
There will be no final exam for this course. The final grade will be calculated from 4 lab reports (60%), an independent project (20%), and 10 quizzes (20%). For those labs that are not covered by a laboratory report, writing a brief summary (lab summary report) is suggested. Each lab summary report can account for additional 1% to your final score. Final grades will be assigned as follows: A, 92 and above; A-, 90-91.99; B+, 87-89.99; B, 83-86.99; B-, 80-82.99; C+, 77-79.99; C, 73-76.99; C-, 70-72.99; D+, 67-69.99; D, 63-66.99, D-, 60-62.99, F, below 60

Attendance:
Attendance is required for all classes. There will be no make-up for missed quizzes.

Lectures:
The lecture will cover materials relevant for the laboratory part. On most labs, there will be multiple short lectures (10-30 min each) spaced at relevant times throughout the day. Students are expected to prepare for each class by reading and studying the required material. Preparation for each class is mandatory. For most classes a short quiz will precede each lecture. It is also important that students familiarize themselves with the experiments and protocols for each class.

Quizzes:
Quizzes will be given at the beginning of class and will last 10-15 min. Each quiz will consist of multiple-choice questions. The material will be contained in the lab manual for the lab on the given day.

Lab summary reports:
For some classes that are not covered by a lab report (Labs 3, 5, and 7), students are encouraged to write a brief (1-2 page) summary report. This should contain data and the short description about what you did and what you learned in the lab. This lab summary report is not mandatory, but if you turn it in by the due date, it might help to improve the final grade as described above.

Lab Reports:
Students will write four laboratory reports. The format for the lab reports is that of scientific publishing, including an abstract, an introduction that briefly reviews the relevant background information, a description of the methods, a results section, and a discussion of the findings. Students will receive verbal and written instructions, along with a few examples.

Independent Projects:
After the first half of the course, students choose an independent project. The project must include image acquisition followed by image processing and/or quantitative image analysis. Although the subject of the study is not limited to a biological sample, students must present a clear scientific question or problem. This project is to be proposed in writing. When you plan the projects, keep in mind that at least the image acquisition part must be completed within two afternoons. Since the independent project is a small two-day project, the emphasis will be on preparation, careful layout of the question addressed, and discussion of experimental results (rather than success of the experiments).

Presentations:
Each group of students will give a presentation about their independent project. Each presentation will cover an introduction, a description of the methods used, a presentation of experimental results, and a discussion of the findings. Each student in one group will take charge of different parts of the presentation.

Required materials:
The laboratory manual for NEU 366L is required for all students. This manual will be distributed on the first day of class by the instructors.

Recommended materials:
A good online resource about light microscopy can be found at http://micro.magnet.fsu.edu/index.html

Students with Disabilities:
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641.

Lab Contents

Lab 1: (Ian Nauhaus) Introduction to light microscopy
Introduction to light microscopy. General design of microscopes and their parts. Build a single lens microscope and a simple microscope. Instructions for data presentation and laboratory report writing.

Lab 2: (Ian Nauhaus) Köhler illumination
Specimen illumination in light microscopes.

Lab 3: (Ian Nauhaus) Image Analysis
Peer evaluation of Lab report 1
Images of simple (diatom) and complex (neuron) specimens will be analyzed using standard software (ImageJ) to extract morphological features quantitatively.

Lab 4: (Ian Nauhaus) Limitations of light microscopy
Limitations of light microscopy, resolution of different microscopy techniques.

Lab 5: (Ian Nauhaus) Contrasting mechanisms
Alignment and adjustment of microscope, Differential Interference Contrast (DIC) microscopy and its limitation.

Lab 6: (Ian Nauhaus) Imaging of dynamic processes 1
Guidance for Independent Projects
Wide-field and confocal fluorescent microscopy. Set up detection scheme using dichroic filters to separate excitation and emission. Dynamic structural changes of live neurons will be imaged and quantified with time-lapse fluorescent microscopy.

Lab 7: (Hiroshi Nishiyama & Ian Nauhaus) Imaging of dynamic process 2
Proposal discussion of Independent Projects
Fluorescence calcium signals in neuronal populations

Independent Project
Students will carry out independent research projects.

Independent Project
Students will carry out independent research projects.

Presentations
Presentations of research projects.

Lab 8: (Donald Nolting & Ian Nauhaus) Magnetic resonance imaging: Introduction to MRI
Introduction to magnetic resonance imaging (MIR) techniques and safety training. Instructional and safety videos are available for review. URLs for videos to be posted on class website/BlackBoard.

Lab 9: (Donald Nolting & Ian Nauhaus) Magnetic resonance imaging: Relaxometry
Operation of the MRI scanner, contrast and resolution, and acquisition of phantom and brain images.

Lab 10: (Donald Nolting & Jeffrey Luci) Magnetic resonance imaging: DTI
Diffusion tensor imaging (DTI).

Lab 11: (with Masa Kuwajima) Electron microscopy
Introduction to electron microscopy. Analysis of EM images to reconstruct neuronal compartments.

Lab 12: (Ian Nauhaus).
Last day of class.