Physics 6780 **Research Methods in Biomedical Physics** **Winter 2018**

Time:	Tuesday & Thursday 1:00 PM to 3:30 PM
Room:	177 Physics
Organizer & co-instructor:	Ashis Mukhopadhyay, Associate Professor
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TA for this class: Namita Shokeen, namita.shokeen@wayne.edu

Suggested Books:

1. Fundamentals of Light Microscopy and Electronic Imaging. Murphy and Davidson (Wiley-Blackwell).
2. Data Reduction and Error Analysis for the Physical Sciences. Bevington and Robison (McGraw-Hill)
3. An Introduction to Computer Simulation Methods: Applications to Physical System. Gould, Tobochnik, and Christian. www.opensourcephysics.org
4. Digital Image Processing. Gonzalez and Woods. (Pearson)
5. Computational Statistics Handbook with Matlab. Martinez and Martinez (CRC Press).

Learning Outcomes:

- Get familiar with experimental methods used in the field of Biomedical Physics, including optical microscopy, atomic force microscopy (AFM), and scattering techniques.
- Solve mathematical models numerically.
- Learn simulation of stochastic processes.
- Analyze and manipulate images.
- Develop skills such as:
  Experiment designing and problem solving;
  Basic skills of bench work, such as pipetting, measuring mass and making buffer;
  Interpretation and analysis of experimental data;
  Writing scientific papers and technical reports;
  Presenting professional seminars and answering questions from the audience.

Syllabus: The course consists of usual lectures by the instructor, 5 guest lectures, and hands-on research projects. The lectures will take place at the indicated days and times. A quiz will be given in the class after the presentation of materials. The course will begin with error analysis in a measurement. Then we will discuss the concept of probability and some useful probability distributions. This part will finish with sampling and employing random numbers for Monte Carlo simulation. While the lecture will focus on to introduce students to these concepts, it will be accompanied by short quizzes and homework. The students are expected to complete at least 3cr hours of computer programming class before taking this course. They can use any programming language to complete the assignments. The next part of the course will discuss image analysis and processing, which is a very useful technique in the field of Biomedical Physics. We will discuss methods, such as convolution, smoothing, denoising, and several filters. Time permitting, we will discuss some advanced topics, including central limit theorem and solving Langevin equation computationally. A couple of lectures will introduce students to various

experimental methods, including light microscopy, atomic force microscopy, diffraction, and transmission electron microscopy. Before the projects start, students will be divided into groups consisting of three members. Each group will work on two to three research projects. There will be two laboratory sections using AFM and light microscopy. Additionally, the students will perform one computer experiment. At the end of the semester, each student will write their own lab report and make a seminar presentation. The reports should have the format of a scientific paper and must follow the guidelines of technical writing.

Some Important dates:

Guest lectures (5 total):

1/18 (Th): Discovery of the porosome: The supramolecular secretory portal in cells (Prof. Bhanu Jena, Dept. of Physiology, School of Medicine)
1/30 (Tu): Library/research methods training (Mr. Jim Van Loon, Wayne State University Library System)
2/22 (Th): Near-field and localization microscopes for measuring plasma membrane organization (Prof. Christopher Kelly, Department of Physics)
2/27 (Tu): Math model of cell injury (Prof. Donald Degracia, Department of Physiology)
3/1 (Th): Biomedical Imaging (Prof. Mohammad R.N. Avanaki, Department of Biomedical Engineering)

Experimental projects and MCAT

4/12 (Th): Biomedical Physics course Assessment (MCAT-Type exam)
4/17 (Tu): Written project report due
4/17 (Tu) & 4/19 (Th): Final presentations

Grading:

Quizzes: 40 points. No make-up quizzes.
Final project: Written part: 30 points Oral presentation: 20 points.
Class involvement: 5 points
MCAT-Type Exam: 5 points

Each student will be evaluated separately for his/her own contribution for the project. Everyone will write their own report.

Total: 100 points
The overall course grade will be determined on the basis of the following table:

Grade	Cumulated score	Grade	Cumulated score	Grade	Cumulated score
A	**90 – 100**	**B-**	**70 – 74**	**D+**	**50 – 54**
A-	**85 – 89**	**C+**	**65 – 69**	**D**	**45 - 49**
B+	**80 – 84**	**C**	**60 – 64**	**D-**	**40 - 44**
B	**75 - 79**	**C-**	**55 - 59**	**F**	**0 – 39**