

Professor: Scott M. LaBrake, Ph.D.

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Office Hours: MW 11:50<sup>am</sup> – 1:00<sup>pm</sup>

By Appointment

Web: <http://minerva.union.edu/labrakes>

Required Text: *Introduction to Physics in Modern Medicine*, 2<sup>nd</sup> Ed. by Suzanne Amador Kane

Recommended Text: *Physics of Radiology*, 2<sup>nd</sup> Ed. By Anthony Wolbarst

Other References:

*Life Science Applications for Physics*, by J. Faughn

*Physics of the Body*, 2<sup>nd</sup> Ed., by J. Cameron, J. Skofronick, & R. Grant

*Biomedical Applications of Intro. Physics*, by J. Tuszynski & J. Dixon

*Physics in Biology and Medicine*, by P. Davidovits

*Human Physiology*, 5<sup>th</sup> Ed., By L. Sherwood

*Clinically Oriented Anatomy*, 5<sup>th</sup> Ed., by K. Moore & A. Dalley

### **Course Description:**

This course introduces the technologies used in modern medicine and the basic physical principles that underlie them. Topics will include: laser surgery, ultrasound imaging, laparoscopic surgery, diagnostic x-ray imaging, nuclear medicine, computed tomography (CAT) scans, magnetic resonance imaging (MRI) scans, and radiation therapy. Safety issues involved in the use of each technique will be considered in depth, and discussions will include societal implications of the growing use of technology in medicine.

Specific medical applications discussed will include (but are not limited to): colon cancer screening, arthroscopic shoulder surgery, laser eye surgery, dermatological laser surgery, obstetrical ultrasound, cardiovascular ultrasound, mammography, osteoporosis screening, lung cancers, bone cancers, radiation therapy, and applications of PET and MRI brain scans in neuroscience.

### **Attendance:**

While attendance is not mandatory, it is expected that you will attend class on a regular basis. Material will be covered in a rapid fashion over the winter term; covering about one chapter per week. Past experience dictates that your success in this class is directly proportional to your attending. There will be several guest lectures by experts from different areas of medicine and medical physics. The dates listed for the speakers are tentative and subject to change, but I will keep you updated. These lecturers give up a substantial amount of time to be with us so courtesy dictates that you will not be absent on these days.

### **Honor Code:**

Union College recognizes the need to create an environment of mutual trust as part of its educational mission. Responsible participation in an academic community requires respect for and acknowledgement of the thoughts and work of others, whether expressed in the present or in some distant time and place.

Matriculation at the College is taken to signify implicit agreement with the Academic Honor Code, available at [honorcode.union.edu](http://honorcode.union.edu). It is each student's responsibility to ensure that

submitted work is his or her own and does not involve any form of academic misconduct. Students are encouraged to work on the assignments together with others in the course. It is expected, however, that the work you hand in to be graded will be written-up independently by you after discussions with other students. Please indicate on the homework who you worked with in preparing the assignment. You may consult, if needed, your textbook, other textbooks, peer-reviewed journals, the physics help center, the Internet, the writing center, your instructor, or other physics instructors in completion of your assignments. Anything that is not directly your own work must be cited. You do not need to cite help that you get from the physics help center or the writing center. In addition, anything that you take from the Internet, other textbooks, journals, and the like must be cited. If you are unsure of anything, you are expected to ask your course instructor for clarification regarding, but not limited to, collaboration, citations, and plagiarism. Ignorance is not an excuse for breaching academic integrity.

Students are also required to affix the full Honor Code Affirmation, or the following shortened version, on each item of coursework submitted for grading: *"I affirm that I have carried out my academic endeavors with full academic honesty."* [Signed, Jane Doe]

### **Course Grade:**

Your course grade will be determined based on a professional judgment of your work on the following scale:

- Exams 35% (Mid-term Exam 15% and a Final Exam 20%)
- Research Paper 25%
- Critiques on Guest Lectures 10%
- Homework 30%

### **Homework:**

The homework assigned is representative of the topics that will be highlighted throughout the term. It is strongly advised that you do the suggested homework as noted in class as well as other relevant problems, of your choosing, on the covered topics from the text.

- The homework will consist of problem solving as well as short answer written responses (remember you're getting WAC credit.)
  - In general, several homework problems will be assigned each night and the problems will be collected during class the following Monday. The solutions to the problems will be posted on my website after class on Monday.
- Once the homework solutions have been posted, late homework will be accepted and will be assigned a value of 50% of the points for the assignment.
- I would advise you talk to me, your classmates, or just ponder the question for a day or so. *Too often students' confuse reading the solution to the problem with their actual understanding of the problem.*
- The mathematical complexity of this course is limited to your ability to do algebra as well as basic mathematical operations.

**Research Paper:**

The research paper gives you an opportunity to investigate a topic that interests you from the field of medicine and/or medical physics and should contain some significant physics content. A partial list of topics will be provided for you to peruse and choose from if you like. However, you are of course free to choose your own topic in consultation with me. I'm going to limit the topics to one per person, unless there is significant difference between topics. Since you will be getting WAC credit this paper should be a significant writing project. Your paper will be graded in stages. The first stage is a written thesis statement of the topic to be investigated with some supporting references. The references need to be from peer-reviewed journals, books, or other scholarly sources. The Internet is not exactly a scholarly source – although there is scholarly material on there. Your paper should contain a minimum of 8 references and the number of references from the Internet is limited to 10% of your total number of references (rounded up to the nearest whole number.) Thesis topic statements, rough drafts, and final drafts will be submitted electronically to the instructor on the due date on or before a time of the instructors choosing.

**Critiques of Guest Lectures:**

This is your opportunity to critique the guest lectures. You should take some notes during their lectures and in your critique write a summary of their lecture giving the main ideas that the lecturer was trying to convey and how those ideas relate to class. Some guest lecturers may make their lecture slides available to you so that you can refer to them. This is not necessarily a given as some material may be copyright, in the process of manuscript production, classified, or if in the author's opinion may jeopardize their research or scholarly interests or activities. You should comment on the applicability of the lecture to the class, difficulty level of the lecture, areas that were particularly good or that were a source of confusion. Your critiques should be a minimum of 2 double spaced pages and these are due the next class meeting following the lecture. Critiques will be submitted electronically to the instructor on the due date on or before a time of the instructors choosing. In the event that you do miss a guest lecture you earn a zero on that critique.

**Proposed Course Schedule:**

## Week #1

- Introduction and Optics – Applications to endoscopic and arthroscopic surgery

## Week #2

- Laser surgery – Applications in ophthalmology, dermatology, general surgery and photodynamic therapy.
- Research paper topics should be chosen by Friday, January 15, 2016

## Week #3

- Ultrasound – Applications in obstetrics and cardiology

Week #4

- X-ray imaging – Applications in mammography and osteoporosis screening

Week #5

- X- ray imaging – CT scans.
- Rough draft of research paper due Friday, February 5, 2016

Week #6

- X- ray imaging – CT scans.
- Mid-term exam on Friday, February 12, 2016

Week #7

- Nuclear Medicine – Applications in radionuclide imaging, bone scans, PET scans and imaging of the brain.

Week #8

- Nuclear Medicine – Applications in radionuclide imaging, bone scans, PET scans and imaging of the brain
- Radiation medicine and safety – Applications in cancer therapy.
- Guest Lecture by *Dr. William Moore, MD*, Dept. of Radiology, NYU Langone Medical Center

Week #9

- Radiation medicine and safety – Applications in cancer therapy.
- Guest Lecture
- Final Research Papers Due Friday, March 4, 2016

Week #10

- Magnetic resonance Imaging – Applications to sports medicine, breast and brain imaging.
- Guest Lecture by *Dr. Rich Simmons, MD*, Class of 1999, Schenectady Neurological Associates, Schenectady, NY