BMED4823 / ECE3803: Introduction to Biomedical Optics

Instructor:

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OFFICE HOUR: Fridays 1-2PM, or after lectures

Class Time and Location: M&W 12:20 pm - 1:35 pm, Molecular Sciences & Engr 1222

Course Objectives:

This Introduction to Biomedical Optics course is to survey fundamentals and applications of optical science, engineering and technology to a broad range of laboratory and clinical biomedical problems. The course is one of the core courses for students interested in the interface of optics and its biomedical applications such as optical imaging, stimulation, diagnostics and therapeutics.

As part of this course, students are expected to:

- apply their knowledge of mathematics and physics to understand optical concepts.
- demonstrate engineering capability to create solutions and interpret data that meet biomedical needs for public health.
- engage in both formal and informal oral professional presentation exercises.
- identify and apply coursework and necessary expertise to address unmet biomedical problems.

Course Material:

1) Required: Lecture Notes
2) Optional: Quantitative Biomedical Optics: Theory, Methods, and Applications by Irving J. Bigio and Sergio Fantini
3) Recommended Software: MATLAB

Grade Assessment:

Four Problem Sets (30%), (See Late Policy)
Two Mid-terms (25%)
Final Exam (25%)
Research Assay (10%), (See Assay Instruction)
Science Presentation (10%), (See Presentation Instruction)

The final grade will be assigned as a letter grade according to the following scale:
A 90-100% ; B 80-89% ; C 70-79% ; D 60-69% ; F 0-59%

Classroom expectations:

1. Preview version of lecture notes will be posted before each lecture. Please print out and bring a copy with you, so you can make notes based on the in-class lecture.
2. Please help me in minimizing screen use in the classroom. There is research evidence showing strong retention linked with handwritten notes. In addition, studies also show detrimental effects of classroom laptops on the students as well as their neighbors. I will not ban screens from the classroom but I ask that you only access devices when necessary.
3. Class attentiveness and participation is very important for your performance in this class.

Date	Course contents
08/19	1. Overview
08/21	2. Basic optics: definitions, photon, frequency, wavelength, ray optics
08/26	3. Basic optics: reflection, refraction, lens and image formation
08/28	4. Basic optics: light propagation, light-matter interaction
09/02	*Labor Day*
09/04	5. Lasers: introduction, laser physics, medical laser safety fundamentals
09/09	6. Lasers: overview of diagnosis and therapy fundamentals with lasers
09/11	7. Laser-tissue interactions: fundamentals, photophysics of laser therapy
09/16	8. Laser-tissue interactions: therapeutic applications
09/18	9. Review lecture
09/23	Midterm I
09/25	10. Optical fibers: fundamentals and light propagation in fibers
09/30	11. Laser-fiber systems: fundamentals, applications, clinical flow chart
10/02	12. Optical tweezers: fundamentals and instrumentation
10/07	13. Optical tweezers: therapeutic applications
10/09	14. Tissue autofluorescence and biomarkers
10/14	*Fall Recess*
10/16	15. Diagnostic optical spectroscopy: fundamentals and instrumentation
10/21	16. Diagnostic optical spectroscopy: applications / Diffuse optics: fundamentals, instrumentation and applications
10/23	17. Diffuse optics: optical tomo/mammography and brain imaging
10/28	18. Review lecture || *Draft Research Assay due*
10/30	Midterm II
11/04	19. Photoacoustics: fundamentals, instrumentation and applications
11/06	20. Neurophotonics: brain stimulation, optogenetics, mini-microscopy
11/11	21. Endoscopy: fundamentals, instrumentation and applications
11/13	22. Computational biomedical optics
11/18	23. Modern optical microscopy for biomedical applications I
11/20	24. Modern optical microscopy for biomedical applications II
11/25	25. Modern optical microscopy for biomedical applications III
11/27	*Student Recess*
12/02	26. Review lecture || *Final Research Assay due*

Notes:

Late Work Policy:

For homework submitted after the deadline (**24 hours max**) without serious excuse and note in advance, a student gets **50%** credit.

Assay Instruction:

The Research Assay is to train and assess students on scientific writing, summary and critical thinking. The report will be 6 pages in length, double spaced, including figures and references on a topic agreed upon by the instructor and student. Two forms of the report are acceptable: **Critical Analysis** of one study, or **Synopsis** of at least 3 articles to describe a key aspect of the field. The students are required to choose one form of report and the paper(s) as the concentration of study (i.e. one paper for Critical Analysis or >=3 papers for Synopsis).

The criteria for the paper(s): **1)** in the general field of biomedical optics (use our course contents in the syllabus as reference), and **2)** the paper(s) have been cited by >100 times by 2019 (per Google Scholar).

Submission guidelines:

1) **Draft of the report** (hard copy only). Due **12:20PM, 10/28/2019**. Page requirement for the draft: 3 pages, double spaced, including figures and references. The draft of the report should use the same format and show the basic outline as in your final report.
2) **Final report** (hard copy only). Due **12:20PM, 12/02/2019**. 6 pages in length, double spaced, including figures and references.
3) Without serious excuse and note in advance, a student gets **80%** credit if missing the draft of the report.

Presentation Instruction:

The Science Presentation is for students to practice scientific reading, analysis and presentation in public. Presentation points are given based on a 5-minute paper presentation plus a 3-minute Q&A. Instructions are stated in detail in the first lecture and posted in Lecture Note #1.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/.

Attendance and/or Participation

Attendance to class is expected, but will not be documented and will not be an explicit part of the final grade. For Institute Absence Policy, please visit http://www.catalog.gatech.edu/rules/4/