

## **ECE/BioE 467 Biophotonics (Syllabus)**

**Instructor:** Prof. Yun-Sheng Chen

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**Office Phone:** 217-300-2801

**Instructor Office Hours:** Thursday, 1:00 – 2:00 pm or by personal appointment

**Lecture:** Tuesdays & Thursdays, 9:30 – 10:50 pm, 2015 ECEB

**Credit:** 3 hours

**Pre-Requisites:** ECE 455, ECE 460, PHYS 402, or Consent of Instructor. A course in biology or physiology is recommended.

### **Course Objective:**

To introduce principles and survey applications in the field of Biophotonics.

### **Instructor Teaching & Learning Philosophy:**

I believe and teach that technology is becoming increasingly interdisciplinary, particularly between engineering, medicine, and biology. Your ability to learn and integrate ideas and concepts from multiple disciplines will enable you to investigate and solve many of the new engineering problems we will face in the future. I value three things in students and colleagues: hard work, productivity, and creativity. To be successful in my course and in life, you must demonstrate that you possess one or more of these three values.

### **Course materials:**

Course slides and reading material will be distributed weekly.

Classroom lectures will emphasize the main points in the material and allow for discussion. I expect you to read the assigned chapters from the reading materials but focus on the concepts presented in the lecture. Homework and exams will be structured with the assumption that you have read all of the assigned text and handout material.

### **Recommended Textbooks for background knowledge in cell biology, pathology, and human physiology:**

Alberts, et al., **Molecular Biology of the Cell**, Garland Science, 5<sup>th</sup> edition, 2008

Kumar, Fausto, Abbas, **Robbins & Cotran Pathologic Basis of Disease**, 9<sup>th</sup> edition, 2014

Vander, Sherman, Luciano, **Human Physiology: The Mechanisms of Body Function**, McGraw Hill, 2004

### **Other Suggested References:**

Saleh and Teich, **Fundamentals of Photonics** (the ECE 460 textbook)  
Hecht, **Optics**, 4<sup>th</sup> edition  
Verdeyen, **Laser Electronics** (the ECE 455 textbook)  
Wang, **Biomedical Optics: Principles and Imaging**  
Born and Wolf, **Principles of Optics**, 7<sup>th</sup> edition  
Hollas, **Modern Spectroscopy**, 4<sup>th</sup> edition  
Vo-Dinh, **Biomedical Photonics Handbook**  
Berlien and Muller, **Applied Laser Medicine**  
Welch and van Gemert, **Optical-Thermal Response of Laser Irradiated Tissue**

### **Homework:**

There will be four graded homework sets for this course. Homework assignments will be distributed approximately 1 week before they are due through Gradescope. Late homework will be accepted, but 10% will be deducted for each day it is late.

### **Problem-Based Learning Report:**

There will be Problem Based Learning Reports due on the last day of class. This report will be a comprehensive description and solution to a set of biophotonics-related questions around a medical/surgical case. Students will be expected to integrate their new knowledge to offer technical-based solutions to help a patient with cancer. There will be one class period workshop set aside to discuss and formalize these reports.

### **Exams:**

Two semester exams will be given in class. You will be allowed to have one equation sheet (front and back) for each successive exam (e.g. total of 2 pages for the exam 2).

An excuse from the Dean's office is the only acceptable excuse for missing an exam.

### **Journal Article Review:**

Each student in the class will be required to present to the class one journal article that will cover related course topics throughout the semester and follow the sequence of topics presented in lectures. Journal articles must be pre-approved by Prof. Chen to emphasize the important topic areas. Selected articles will be shared with the class before the presentation, and all students will be expected to read the article and participate in the discussion. The 15 minute presentation (followed by up to 15 minutes of discussion) should discuss the important points of the article, as well as show and discuss the figures, data, and images. Students will be graded on their presentation, their understanding of the material, and their ability to lead the class discussion.

### **Biophotonics Facilities and Lab Tour:**

Our university has a large number of facilities and resources dedicated to biophotonics research, imaging, and microscopy. One class period will be dedicated to visiting and touring some of these campus resources to see first-hand the technology and instrumentation related to biophotonics and biomedical optical imaging.

**Grading:**

Your final grade in this course will be based on your total score on all the components of the course. The total score is broken down into the following components:

Exam #1	15%
Exam #2	20%
Homework	20%
Problem Report	15%
Article Presentation	20%
Participation	10%
<b>Total</b>	<b>100%</b>

**Absences and Excused Grades:**

There is no way to make up a missed semester exam. An unexcused absence from a semester exam will be assigned a zero grade. An excused absence requires a letter from the Dean's office. An excused absence from a semester exam will receive an EX grade. At the end of the semester, the EX grade will be replaced with the average of your grades on the other exams and the final.

**Grade Disputes:**

Grade disputes on homework will be settled at the discretion of the TA. Grade disputes on the semester exams will be settled at the discretion of Prof. Chen. In both cases, the problem in question will be RE-GRADED, making it possible for you to receive a lower score. To dispute an exam grade, you must explain your dispute IN WRITING and staple this to the front of your exam. Prof. Chen will then re-grade your exam.

Date		Reading material chapter	Topic	Due
January	20	1	Course Introduction	
	22		Intro to Cell Biology	
	27	2	Fundamentals of Light and Matter	
	29		Fundamentals of Light and Matter	
February	3		Principles of Optics	
	5	5	Principles of Lasers	
	10	3	Basics of Cancer Biology	
	12		Basics of Cancer Biology	
	17	6	Optical Properties of Tissues	
	19		Optical Properties of Tissues	
	24	7	Bioimaging	
	26		Bioimaging	HW #1
March	3	8	Bioimaging	
	5		<b>Exam #1</b>	
	10	4	Spectroscopy	
	12		Spectroscopy	
	17		Spring Break	
	19		Spring Break	
	24	8.1-8.2	Contrast Agents	
	26	9	Optical Biosensors	
	31		Optical Biosensors	
April	2		Problem-Based Learning Workshop	
	7		Biophotonics Facilities and Lab Tour	
	9	13	Light-Activated Therapy	
	14		Neuronal stimulation with light	HW #2
	16	12	Neuronal stimulation with light	
	21		<b>Exam #2</b>	
	23		Article Presentation	
	28		Article Presentation	
	30		Article Presentation	
May	5		Article Presentation	Report Due