

Course Information

Instructor:

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Description:

The medical field has become one of the fastest growing technological applications. Medical Imaging combines knowledge of unique physical phenomenon (sound, radiation, magnetism, etc.) with high speed electronic data processing, analysis and display to generate an image. The goal of this course is to introduce fundamentals of medical imaging to prepare students to enter the workforce or post-graduate education in the medical field. We will study five general medical imaging modalities: projection radiography, computed tomography, magnetic resonance imaging, nuclear / PET imaging, and ultrasound. In addition there will be one module on imaging theory that is applicable to all the modalities.

Text:

The Essential Physics of Medical Imaging, by J.T. Bushberg, J. A. Seibert, E. M. Leidholdt, and J. M. Boone, Lippincott Williams & Wilkins, 2002.

Prerequisites:

Junior or Senior standing. Some knowledge of linear signals and systems, convolution, basic probability, 1D Fourier Transforms is helpful.

Lectures/Labs: MTRF, Period 8 2:30pm

Office Hours: TBD. I have an open door policy.

Course Learning Objectives

In the following course objectives, the student will...

1. **Define** and appropriately **use** common medical imaging terms associated with the 5 standard imaging modalities: X-ray, Computed Tomography, Nuclear, Magnetic Resonance, and Ultrasound
2. **Describe** the theoretical basis for the signal generation exploited by each medical imaging system
3. **Recognize** and **describe** the operation of the components of each medical imaging system
4. **Apply** basic laws of physics to make **computations** related to medical imaging systems
5. Given specific instruction **model** each medical imaging systems and generate a resulting image
6. Given examples of out-of-the-box system designs described in current medical physics literature, **analyze** and **compare** the innovations in a written paper.

Grading

Grades will be based on, module exams, homework, papers and group work. There is no final exam scheduled for this class.

Relative Grading Rates

	Relative Weight	Number	weight each
Module Exams	45%	6	~8%
Homework	40%	9	~4%
White Papers/Lab tour	10%	4	~3%
Participation/Group work			
DyKnow Points	5%		
Total	100%		

Grading Scale

A	90 – 100
B+	85 - 89
B	80 – 84
C+	75 – 79
C	70 – 74
D+	65 – 69
D	60 – 64
F	Below 60

Module Exams:

The class is organized into 6 modules. For each module there are a defined set of learning objectives that will be provided to you. Module exams will be in-class, closed-book exams, approximately 25 minutes in length. You will be allowed one 8.5x11 inch note page to record reference material that you have made but you may not use anyone else's notes.

Homework:

There will be weekly homework assignments, which will include hand calculations as well as several Matlab based analyses. You must attempt to solve all homework problems by yourself, and implement all homework-related computer programs by yourself. Copying homework solutions or computer code from another student is a clear violation of the institute's Code of Ethics. However, after making a genuine attempt to solve the homework problems, you are encouraged to discuss the answers with other students currently enrolled in ECE497 to check the answers and compare solution approaches. After such a discussion, you may rewrite your answer as long as you do so individually, without referring to the solutions of others.

Late policy: 25% deduction per day. Flexibility is extended to students attending conferences or job interviews, provided permission is obtained prior to the due date.

Paper Assignments

In order to develop analysis skills associated with medical imaging systems, use current scientific journals as resources, and practice effective written communication skills, students will be required to turn in 3 white papers. You will be given journal articles from scientific peer reviewed literature. You will analyze and compare these articles and write an authoritative report.

Lab Tour

We will plan to tour the Medical Imaging Research facility at IUPUI in Indianapolis. This is a great opportunity to see state-of-the-art systems, such as PET, CT, and MRI in a clinical and research environment. Class will be canceled this day and we will plan to leave campus at 2:15 pm in the afternoon and return around 7 pm. This proposed schedule means that students might miss another class or experience conflicts with extracurricular activities. I expected that other instructors or coaches will recognize the unique opportunity to attend this lab tour and make allowances for students to make up any work that they might miss. If it is impossible to work out the conflict, then students can miss the lab tour and earn credit by completing an additional white paper.

Participation

DyKnow In order to enhance the learning experience within the classroom we will be using pen-based computers called tablets and DyKnow software. DyKnow transmits the instructor's handwriting, text, images, and Web content to each student's workstation, where students can take notes and annotate the material. You should come to class prepared to engage the material and participate fully. We will all benefit from your contributions. You are not permitted to read email, browse the Web, play computer games, etc. while class is in session.

Attendance Regardless of whether formal attendance is taken, attendance at each class is expected. Experience has shown that regular attendance improves learning, and consequently improves test and homework performance. In addition 5% of your grade is derived from classroom participation. During lecture and group work activities you will have the opportunity to earn *DyKnow Points* by submitting your work and answering poll questions. I will record your *DyKnow Points* by reviewing the work you submit in class. It is not possible to replicate the classroom or group work experience; therefore it is not possible to make-up *DyKnow Points*. If you miss class you will miss an opportunity to earn *DyKnow Points*.

Disability Accommodation:

If you require disability accommodations, contact The Learning Center (contact by phone: (812) 877-8876, Campus mail: box # 82, or Email: learningcenter@rose-hulman.edu) to make initial arrangements and then contact the instructor.

Course Calendar

	Week	Date	Lecture Topics	Due	
1	week 1		Introduction history		
2			Basic concepts		
3			Projection Radiography		
4					
5	week 2			Out of box paper due History	
6					
7					
8				Xray Computed Tomography	Homework 1 due
9	week 3			Exam 1	
10					
11					
12				Homework 2 due	
13	week 4				
14				Imaging Theory	Exam 2
15					
16				Homework 3 due	
BREAK					
17	week 5			Out of box paper due CT	
18					
19					
20				Nuclear Imaging	Homework 4 due
21	week 6			Exam 3	
22					
23					
24				Homework 5 due	
25	week 7				
26				Magnetic Resonance Imaging	Exam 4
27					
28				Homework 6 due	
29	week 8				
30				Out of box paper due Detectors	
31					
32				Homework 7 due	
33	week 9		imaging center visit		
34			Ultrasound	Exam 5	
35					
36			Homework 8 due		
37	week 10				
38				Lab visit or paper - trade off imaging modalities	
39				Homework 9 due	
40				Future works	Exam 6