ECE/BIOE 380: Biomedical Imaging
Fall 2025, Tu/Thur: 9:30 – 10:50am, 158 Loomis Laboratory
https://canvas.illinois.edu/courses/58887

Instructor:
Guillermo L Monroy, PhD
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Looking forward to a productive semester!

Office Hours and TA:
TA: Zihao Huang
Location and Time TBD

- Please contact course staff through the Canvas portal -

Required Text:
The lecture slides will be your main source of studying materials, but I strongly encourage you to read the assigned chapters associated with the suggested textbooks. I will post the marked-up lecture notes onto canvas.

The Essential Physics of Medical Imaging, 4th Edition, by Bushberg *et al*., LWW, 2020.
Fundamentals of Medical Imaging, 3rd Edition, by Paul Suetens, Cambridge University Press, 2017.

Please note: You can access these textbooks for free online using your campus library access:
Bushberg (Online portal): https://oce.ovid.com/book?SerialCode=02211181

Seutens (Can download PDFs): https://www.cambridge.org/core/books/fundamentals-of-medical-imaging/E9D727DBE7EB6150768A74F655C07BAC

Credit: 3 undergraduate hours. Course info: https://courses.illinois.edu/schedule/2025/fall/ECE/380

Meeting Schedule/Contact Hours: Two 80-minute lecture-discussions per week

Overview: Physics and engineering principles associated with x-ray, computed tomography, nuclear, ultrasound, magnetic resonance, and optical imaging (various techniques), including human visualization and perception of image data.

Course Objectives: (More detail here https://ece.illinois.edu/academics/courses/ece380-120258):

At the end of the course, the student should be able to:

- Understand the fundamentals and applications of five medical imaging techniques: x-ray imaging and computed tomography, nuclear medicine, magnetic resonance imaging, ultrasound, and optical imaging.
- Comprehend general image formation concepts, including human visual perception and psychophysics.
- Demonstrate understanding of contrast mechanisms of these various techniques.
- Be competent in applying fundamental formulas that quantify contrast or other image metrics.
- Be familiar with the use, application, and limitation of these tools in healthcare settings.

Homeworks: 8 graded homework assignments will be given that require the students to demonstrate the concepts learned during the reading and lecture portions of the course. Solutions will be made available for all problems, and it is the student's responsibility to ensure that all problems were understood to prepare for exams. **Late homework will not be accepted.**

Required software: **Matlab** will occasionally be used for homeworks. It is available online as part of a campus wide agreement, or, downloadable through the WebStore if you prefer to run it locally. I recommend getting this set up early – difficulties setting up software are not a valid excuse (especially with the web portal availabiltiy).

Note: Students may discuss homework problems but should write up solutions independently with their own work.

Assignments will be turned in through **gradescope.com** and is integrated within canvas. Please read the instructions carefully, sign up and ***get your account activated ahead of the first homework deadline*** and ask questions if grading explanations are not clear. Please contact the lecturer for any other problems related to gradescope.

Exams and/or Quizzes: The course will consist of two midterm exams and a comprehensive final exam.

Final Project: N/a

Grading:

		Grading Scale			
Midterm Exam 1	20%				
Midterm Exam 2	20%	A+	≥95%	C	≥74%
Final Exam	20%	A	≥92%	D+	≥69%
Homework	30%	B+	≥86%	D	≥66%
Class participation	10%	B	≥83%	F	≥60%
Total:	100%	C+	≥77%		

Note: Minus grades (A-) not listed but will be used when entering grades at the end of semester.

Additional Expectations:

1. The student will consider the readings as required material and may be tested on items not covered during lecture. Readings are important to provide well-rounded knowledge and alternate explanations, though lecture material is the main source of information as the course progresses.
2. Grading is left to the discretion of course staff. Students are expected to study the solution sets to ensure that they have understood all of the problems assigned.
3. *Ethics and Integrity*: Students are expected to uphold the highest ethical standards, be honest, and practice academic integrity. This includes doing original work and citing any sources used. Group discussions with classmates (only those currently enrolled in the course) about course content and homework is encouraged. However, all work submitted by you must be your own work. No discussion is allowed on exam problems (duh). Please see the academic integrity statement at the University's policy on academic integrity, found in the *Code of Policies and Regulations Applying to All Students* under Article 1, Part 4: Academic Integrity Policy and Procedure.
4. **Homework is due as noted in Canvas**, unless otherwise noted in class or via canvas announcement. Homework not turned in on time will not be accepted unless there is a significant circumstance or granted by various campus authorities.
5. Students will be expected to track their grades and verify its accuracy by frequently checking the grades in gradescope.com and the Canvas site, as appropriate.

Illness and absence policy – PLEASE READ

See: https://studentcode.illinois.edu/article1/part5/1-501

Any unexcused or missed homework / exam will result in a 0. However, life does not schedule illness, emergencies, accidents, family events, etc. conveniently - Please contact the instructor *as soon as possible* to make accommodations. Any reasonable request will be considered and are at the discretion of course staff. This course will not record attendance, and so written permission to miss class due to conflicts is not required. However, regular class attendance is expected, encouraged, and highly correlated with course performance. A quick note is always appreciated to help maintain class continuity. If you decide to come to class and may be sick – you are encouraged to wear a mask to support your fellow campus members.

To attain excused absences / accommodations: Other than contacting the instructor, follow campus policies outlined in the link above or in the following sections. If you are ill, please take some rest and notify your instructor within a reasonable time frame and ahead of time if possible. For exams, you must contact your instructor **immediately** / **as soon as possible**. Depending on the severity and length of time away, an excused absence form may need to be filed, or coordinate with official notice from DRES, ECE / BIOE Departments, Emergency Dean, etc.

Students are expected to remain current on campus COVID-19 policies, located at: https://covid19.illinois.edu/ and ask questions if a process is not clear. Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community.

GENERAL EXPECTATIONS FOR ALL COURSES:
See: https://grainger.illinois.edu/academics/online/current-students/policies

Anti-Racism and Inclusivity Statement
The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Community of Care
As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050) or online at:http://odos.illinois.edu/community-of-care/referral/ . Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Furthermore, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at McKinley Health Center (https://mckinley.illinois.edu/) or the Counseling Center (https://counselingcenter.illinois.edu/). For urgent matters during business hours, no appointment is needed to contact the Counseling Center. For mental health emergencies, you can call 911.

Disruptive Behavior
Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the Office for Student Conflict Resolution (https://conflictresolution.illinois.edu; conflictresolution@illinois.edu; 333-3680) for disciplinary action.

Emergency Response Recommendations
Emergency response recommendations can be found at the following website:
http://police.illinois.edu/emergency-preparedness/.
I encourage you to review this website and the campus building floor plans website within the first 10 days of class (floor plans near bottom – we are at 1304 W. Green St , building ID: u0034):
http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans/.

Family Educational Rights and Privacy Act (FERPA)
Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

Mental Health and Counseling Services
Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

Counseling Center (217) 333-3704
McKinley Health Center (217) 333-2700
National Suicide Prevention Lifeline (800) 273-8255
Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

*This statement is approved by the University of Illinois Counseling Center.

You can always contact the instructor if you have any concerns or need any help.

Religious Observances
Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, we request that students make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation
The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.
Other information about resources and reporting is available here: wecare.illinois.edu.

Campus approved accommodations
To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the as soon as possible. To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail disability@illinois.edu. http://www.disability.illinois.edu/.

Class Schedule on next page (Subject to change, will be kept up to date on Canvas)

Date		Lecture #	Lecture Deck	Pre-reading	Lecture Topic	HW released (Gradescope)	HW due (Gradescope)
August	26	1	1	1 (Bushberg)	Syllabus review + Intro to Biomedical Imaging		
	28	2	2	Notes	Fourier Transform + Properties I	**HW #1 (L1-2)**	
September	2	3	2	Notes	Fourier Transform + Properties II		
	4	4	3	1 (Suetens); 4.1-4.5, 4.7-4.9 (Bushberg)	Basic physics review, Image Properties and Processing	**HW #2 (L3)**	**HW #1 (L1-2)**
	9	5	3	2 (Suetens); 6.1-6.2, 7.1-7.2, 7.5 (Bushberg)	Basic physics review, Image Properties and Processing		
	11	6	4	2 (Suetens); 6.1-6.2, 7.1-7.2, 7.5 (Bushberg)	X-Ray Imaging	**HW #3 (L4)**	**HW #2 (L3)**
	16	7	4	2 (Suetens); 6.1-6.2, 7.1-7.2, 7.5 (Bushberg)	X-Ray Imaging		
	18	8	5	3 (Suetens); 10.1-10.5 (Bushberg)	Computed Tomography (X-ray)	**HW #4 (L5)**	**HW #3 (L4)**
	23	9	5	3 (Suetens); 10.1-10.5 (Bushberg)	Computed Tomography (X-ray)		
	25				**Mid-term exam 1**	**Exam during class time**	**Covers L1-4 / H1-3**
	30				**No Class**		
October	2	10	5	3 (Suetens); 10.1-10.5 (Bushberg)	Computed Tomography (X- ray)		
	7	11	6	6 (Suetens); 15, 16.1-16.2, 18.1, 19.1-19.3 (Bushberg)	Nuclear Medicine Imaging	**HW #5 (L6)**	**HW #4 (L5)**
	9	12	6	6 (Suetens); 15, 16.1-16.2, 18.1, 19.1-19.3 (Bushberg)	Nuclear Medicine Imaging		Mid-semester survey
	14	13	7	4 (Suetens); 12 (Bushberg)	Magnetic Resonance Imaging + Survey Review	**HW #6 (L7)**	**HW #5 (L6)**
	16	14	7	4 (Suetens); 12 (Bushberg)	Magnetic Resonance Imaging		
	21	15	7	4 (Suetens); 12 (Bushberg)	Magnetic Resonance Imaging		
	23	16	7	4 (Suetens); 12 (Bushberg)	Magnetic Resonance Imaging		
	28	17	8	5 (Suetens); 14.1-14.7 (Bushberg)	Ultrasound Imaging	**HW #7 (L7)**	**HW #6 (L7)**
	30	18	8	5 (Suetens); 14.1-14.7 (Bushberg)	Ultrasound Imaging		
November	4				**Mid-term exam 2**	**Exam during class time**	**Covers L5-7 / H4-6**
	6				**No Class**		
	11	19	8	5 (Suetens); 14.1-14.7 (Bushberg)	Ultrasound Imaging		
	13	20	8	5 (Suetens); 14.1-14.7 (Bushberg)	Ultrasound Imaging		
	18	21	9 + 10		Optical imaging	**HW #8 (L8)**	**HW #7 (L7)**
	20				Fall Break Nov 22-30		
	25				Fall Break Nov 22-30		
	27	22	9 + 10		Optical imaging		
December	2	23	9 + 10		Optical imaging		
	4	24	9 + 10		Optical imaging, Visual Perception + Class Summary		**HW #8 (L8)**
	9				**TBD or No Class (flex slot)**		
	11				**Reading day**		
				Finals Week Dec 12-18	**Final exam**	Location TBD	**Covers all material**