IMPORTANT: This syllabus form should be submitted to OAA (gsbs_academic_affairs@uth.tmc.edu) a week before the start of each semester.

NOTE to STUDENTS: If you need any accommodations related to attending/enrolling in this course, please contact one of the Graduate School's 504 Coordinators, Natalie Sirisaengtaksin, PhD. We ask that you notify GSBS in advance (preferably at least 3 days before the start of the semester) so we can make appropriate arrangements.

Term and Year: **Spring 2026** Course Number and Course Title: **GS02 1103: Intro to Medical Physics II: Medical Imaging** Credit Hours: **3** Meeting Location: **MDA Faculty Center** Building/Room#**: FCT14.5059** WebEx/Zoom Link: **Will provide when classes start**	**Program Required Course: Yes** **Approval Code: Yes** **(If yes,** the Course Director or the Course Designee will provide the approval code.) **Audit Permitted: No** Classes Begin: **January 12, 2026** Classes End: **May 1, 2026** Final Exam Week: **May 4 – 8, 2026**

Class Meeting Schedule

Day	Time
M-W-F	**11:00 am – 12:00 noon**

Course Director

Name and Degree: **Ke Li, PhD**

Title: **Associate Professor**

Department: **Imaging Physics**

Institution: *MDACC*

Email Address: kli7@mdanderson.org

Contact Number: 713-745-1771

NOTE: Office hours are available by request. Please contact Dr. Li to arrange a time to meet.

Teaching Assistant: (if any)

N/A
Name and Email Address

Instructor/s

1. **Moiz Ahmad, PhD**
   Institution: MDACC
   Email Address: MAhmad@mdanderson.org
2. **Frank Dong, PhD**
   Institution: MDACC
   Email Address: FDong1@mdanderson.org
3. **Janet Ching-Mei Feng, PhD**
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	5. **Carly Hansen, MS** Institution: Texas Children's Hospital Email Address: cmhansen@texaschildrens.org 6. **Megan Jacobsen, PhD** Institution: MDACC Email Address: mcjacobsen@mdanderson.org 7. **Ke Li, PhD** Institution: MDACC Email Address: kli7@mdanderson.org 8. **Xinming Liu, PhD** Institution: MDACC Email Address: XLiu@mdanderson.org 9. **Raymond Benton Pahlka, PhD** Institution: Texas Children's Hospital Email Address: rbpahlka@texaschildrens.org 10. **John Rong, PhD** Institution: MDACC Email Address: John.Rong@mdanderson.org 11 **Jeff Siewerdsen, PhD** Institution: MDACC Email Address: JHSiewerdsen@mdanderson.org

Course Description:

This course provides an overview of x-ray production, x-ray interactions, x-ray detectors, x-ray radiography, fluoroscopy, mammography, computed tomography (CT), and picture archiving and communication systems (PACS). Topics include the fundamental principles of diagnostic x-ray and CT imaging physics, the key characteristics of each imaging modality, and the major components of imaging chain systems. Emphasis is placed on image formation and reconstruction, image quality assessment, radiation dosimetry, and clinical applications in diagnostic x-ray and CT imaging.

Textbooks

- **The Essential Physics of Medical Imaging, 4th edition, Bushberg, et al, Wolters Kluwer, 2021. ISBN: 9781975103224, $215.99**

Course Objective/s:

Upon successful completion of this course, students will understand the basic principles of medical x-ray imaging physics, imaging technologies, systems, and acquire hands-on experiences including radiography, mammography, and computed tomography.

***Specific Learning Objectives*:**

1. Understand the basic principles of medical x-ray imaging physics and describe the fundamental characteristics of each x-ray imaging modality.
2. Identify the major components of medical imaging systems, describe the basic design of imaging technology, and explain the principles of image formation and reconstruction.
3. Identify and describe the attributes used to assess the performance/image quality of an imaging system.
4. Understand how image quality and patient radiation dose are affected by x-ray interactions.
5. List the image acquisition parameters, and explain how each affects the image quality and/or patient radiation dose.

Student Responsibilities and Expectations:

Students enrolled in this course will be expected to perform the following activities:

1. Attend classroom lectures
2. Participate in hands-on labs
3. Participate in and contribute to course discussions during lecture, review sessions, and hands-on labs
4. Study course materials (e.g. textbook, lecture slides, lab instructions, literatures)
5. Complete course assignments (e.g. homeworks, projects, lab reports) on time
6. Prepare for and take examinations

Students are expected to complete all assigned reading material (e.g. textbook chapters, lab instructions) prior to class/lab. While you may work and discuss all course materials and assignments in groups, all writing assignments must be your own. Plagiarism and failure to properly cite scientific literature and other sources will not be tolerated and are grounds for dismissal from the course and further GSBS disciplinary action. Cheating or engaging in unethical behavior during examinations will be grounds for dismissal from the course without credit and further GSBS disciplinary action.

Grading System: **Letter Grade (A-F)**	
Student Assessment and Grading Criteria: *(May include the following:)*	
Percentage	**Description**
Homework (10-15%)	Assigned by the individual instructor as needed
Quiz (0%)	Assigned by the individual instructor as needed
Presentation (0%)	Assigned by the individual instructor as needed
Exams (~60%)	3 exams total
Workshop or Lab (~25-30%)	4 Hands-on labs and 1 project assignment
Participation and/or Attendance (0%)	Students are required to attend the entire class.

CLASS SCHEDULE

Date	Duration	Lecture Topic	Instructor
X-RAY A			
1/12	1h	Course overview, introduction to diagnostic imaging modalities and image physics practices	Li
1/14	1h	X-ray production: x-ray tube structure, anode, cathode, focal spot, x-ray filtration	Dong
1/16	1h	X-ray production: x-ray generator, AEC	Dong
1/19	1h	Martin Luther King Holiday (no class)	
1/21	1h	X-ray interactions, attenuation coefficients, beam quality	Dong
1/23	1h	Radiography: image formation, H&D, focal spot blurring	Li
1/26	1h	Radiography: latitude, contrast, dose, scatter, image noise	Li
1/28	1h	Historical development and physics principles of mammography systems, modes of operations	Geiser
1/30	1h	Mean glandular dose, ACR QC tests	Geiser
2/2	1h	Digital Radiography/Mammography: digital detectors, CCD, CR, FP	Liu
2/4	1h	Digital Radiography/Mammography: digital image correction, image processing and enhancement	Liu

2/6	1h	Advances in radiography: dual energy, digital tomosynthesis	Liu
2/9	1h	Standards, networks/gateways, PACS, displays	Liu
2/11	1h	"Big Data", basic image processing, 3D visualization and printing, and AI	Liu
2/13	1h	"X-Ray A" review session	Dong, Geiser, Li, Liu
X-RAY B			
2/16	1h	Fluoroscopic imaging chain and components, x-ray source assembly	Rong
2/18	1h	Controls, modes of operation, image processing, image quality and radiation dose in fluoroscopic procedures	Rong
2/20	1h	Image quality, patient radiation management, personnel radiation safety in fluoroscopy	Rong
2/23		Exam 1: X-Ray A (11:00am – 12:30pm)	Li
2/25	1h	Image Quality I: Image Signal and Contrast	Li
2/27	1h	Image Quality II: Spatial Resolution, PSF, MTF	Li
3/2	1h	Image Quality III: Noise Properties, NPS	Li
3/4	1h	Image Quality IV: NEQ and DQE	Li
3/6	1h	Observer Performance – Perceptional Study, ROC	Li
3/9-13	1h	Spring Break (no classes)	
3/16	1h	Review radiation terms and units, dose metrics, radiation dose in x-ray imaging, diagnostic reference levels and achievable doses	Dong
3/18	1h	Overview of radiation protection in diagnostic imaging	Feng
3/20	1h	Structural shielding in diagnostic imaging	Feng
3/23	1h	X-ray pediatric imaging considerations	Pahlka
3/25	1h	Radiation dose monitoring, reporting, and management	Brown
3/27	1h	"X-Ray B" review session	Li, Rong
3/30		Exam 2: X-Ray B (11:00am – 12:30pm)	Li
COMPUTED TOMOGRAPHY			
4/1	1h	CT fundamentals and historical development, CT practices at MDA	Li
4/3	1h	CT system designs	Rong
4/6	1h	CT imaging acquisition modes	Rong
4/8	1h	CT Reconstruction: projection and sinogram, filtered backprojection, reconstruction algorithms	Ahmad
4/10	1h	CT Reconstruction: concept of cone beam, iterative, and Deep Learning based reconstructions, available clinical options	Ahmad
4/13	1h	CT Image Quality: spatial resolution, low-contrast detectability, noise/CNR, factors affecting CT image quality, tools/phantoms for image quality evaluation	Jacobsen
4/15	1h	CT Image Quality: causes of image artifacts and possible solutions for artifact reduction	Jacobsen
4/17	1h	Clinical CT applications	Jacobsen
4/20	1h	CT radiation dosimetry	Ahmad

4/22	1h	CBCT basics, development, and clinical applications	Siewerdsen
4/24	1h	Advanced CT technology I	Jacobsen
4/27	1h	Advanced CT technology II	Jacobsen
4/29	1h	Pediatric CT imaging considerations and applications	Hansen
5/1	1h	CT review session	Ahmad, Jacobsen, Li, Rong
5/5		Exam 3: CT (9:30 – 11:00am)	Li