

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 Coordinator, 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: Summer 2026 Course Number and Course Title: GS02 1223: Diagnostic Medical Physics II (introduction to Ultrasound and MR Physics) Credit Hours: 1 Meeting Location: UT MDACC Main Building Building/Room#: 3SCR2.3932 (US) and FCT 14.5059 (Room 4)	Program Required Course: Yes Approval Code: Yes (If yes, the Course Director or the Course Designee will provide the approval code.) Audit Permitted: Yes Classes Begin: May 19, 2026 Classes End: August 4, 2026 Final Exam Week: August 8, 2026				
Class Meeting Schedule (In-person unless specified) <table border="1"> <thead> <tr> <th>Day</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>Tuesdays and Thursdays</td> <td>9:30-11:00 a.m. (Ultrasound); 10:00-11:30 a.m. (MRI)</td> </tr> </tbody> </table>		Day	Time	Tuesdays and Thursdays	9:30-11:00 a.m. (Ultrasound); 10:00-11:30 a.m. (MRI)
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Course Director: Name and Degree: Richard Bouchard, PhD Title: Professor Department: Imaging Physics Institution: MDACC Email Address: RRBouchard@mdanderson.org Contact Number: 713-745-0626 Co-Course Director: Name and Degree: R. Jason Stafford, PhD Title: Professor Department: Imaging Physics Institution: MDACC Email Address: JStafford@mdanderson.org Contact Number: 713-745-5082	Instructors 1. R. Jason Stafford, PhD Institution: MDACC Email Address : JStafford@mdanderson.org 2. Richard Bouchard, PhD Institution: MDACC Email Address : RRBouchard@mdanderson.org				

NOTE: Office hours are available by request. Please email me to arrange a time to meet.

Course Description:

This course provides graduate students with a foundation in the fundamental physics, principles of image formation, and reconstruction, instrumentation, safety, and quality assurance of ultrasound and magnetic resonance imaging.

Textbook/Supplemental Reading Materials

- Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidhody, Jr, and John M. Boone, The Essential Physics of Medical Imaging, Third Edition. ~\$205
- Douglas Christensen, Ultrasonic Bioinstrumentation, John Wiley & Sons, 1991, ISBN 978-0471604969. ~\$240

Course Objective/s:

Upon successful completion of this course, students will

Specific Learning Objectives:

1. Outline and review fundamental physics underlying Ultrasound & MRI.
2. Describe and explain key principles of Ultrasound & MR image formation and contrast.
3. Name common Ultrasound & MR acquisition techniques and explain underlying physical principles of operation, advantages, and disadvantages.
4. Identify common Ultrasound & MRI artifacts and quality control methodologies.
5. Recognize key safety risks in Ultrasound & MRI and explain underlying physical principles.

Student Responsibilities and Expectations:

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

1. Read, process, and review (student) material from assigned reading in textbooks or provided literature.
2. Complete assigned homework and participate in discussions of assignments in class.
3. Prepare for and take course quizzes based on course lectures/ readings.
4. Participate in and contribute to course discussions during lecture, review sessions
5. Participate in and complete assigned work in laboratory sessions
6. Prepare for and take a final examination based on lecture and some reading material.

Students are expected to complete all assigned reading material prior to class. While you may work and discuss all course materials and assignments in groups, all 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 (quizzes and exams) 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 (35 %)	Homework, projects, and laboratory
Final Exam (65 %)	Cumulative Exam

CLASS SCHEDULE:

Summer 2026 GS02 1223 - Diagnostic Medical Physics II:

Introduction to Ultrasound & MR Physics

Course Coordinators: Richard Bouchard, PhD & R. Jason Stafford, PhD
Lectures: Tuesdays and Thursdays (in-person unless specified)
 9:30-11:00 a.m. (Ultrasound); 10:00-11:30 a.m. (MRI)
 Room 3SCR2.3932. (US) and FCT14.5059 (MR)
Labs: Day, time, and location vary (TBD by coordinator and students)
Grading: Ultrasound and MR sections weighted equally.
 65% exams + 35% participation/assignments

Course Schedule

	DATE	TITLE	INSTRUCTOR
1	05/19	Introduction to Ultrasound	Bouchard
2	05/21	Ultrasound Interactions with Tissue I	Bouchard
3	05/26	Ultrasound Interactions with Tissue II	Bouchard
4	05/28	Beamforming I	Bouchard
5	06/02	Beamforming II	Bouchard
6	06/04	Ultrasound Imaging I	Bouchard
7	06/09	Ultrasound Imaging II	Bouchard
8	06/11	Ultrasound Imaging Artifacts	Bouchard

9	06/16	Ultrasound Quality Assurance & Safety	Bouchard
10	06/18	Advanced Ultrasound Imaging	Bouchard
	06/23	Exam 1: Ultrasound Physics	Bouchard
11	06/25	Introduction to Magnetic Resonance	Stafford
12	06/30	Signal Generation & Contrast Concepts	Stafford
13	07/02	Pulse Sequences I: The Spin Echo	Stafford
14	07/07	Image Formation: Sampling & Reconstruction	Stafford
15	07/09	Signal, Contrast & Noise in MRI	Stafford
16	07/14	MR Instrumentation	Stafford
17	07/16	Artifacts & Principles of Quality Assurance	Stafford
	07/21	NO CLASS (AAPM MEETING)	Stafford
18	07/23	Pulse Sequences II: Magnetization Prep.	Stafford
19	07/28	Pulse Sequences III: Fast Imaging & Clinical	
20	07/30	Advanced MRI: Physiology & Function	Stafford
21	08/04	MR Safety for Medical Physicists	Stafford
	08/06	Exam 2: MRI Physics	Stafford
	TBA	LAB 1: US acquisition & reconstruction	TBA
	TBA	LAB 2: MR Pulse Sequences & Contrast	TBA
	TBA	LAB 3: Post-Processing in MRI	TBA
	TBA	LAB 4: Principles of MR Quality Control	TBA

Strongly Recommended Textbooks

Douglas Christensen, *Ultrasonic Bioinstrumentation*, John Wiley & Sons, 1991, ISBN 978-0471604969. ~\$240

Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, Jr., and John M. Boone, *The Essential Physics of Medical Imaging*, 4th Ed., Philadelphia: Wolters Kluwer | Lippincott, Williams & Wilkins, 2021, ISBN 978-0781780575. ~\$212 **[BB in the readings]**

Other Useful Textbooks

Robert W. Brown, et al., *Magnetic Resonance Imaging: Physical Principles and Sequence Design, Second Edition*, New York: Wiley, 2014, ISBN 978-0471720850. \$250. **[Haacke in the readings]** ([Full Access for MDACC](#))

Zhi-Pei Liang and Paul C. Lauterbur, *Principles of Magnetic Resonance Imaging: A Signal Processing Perspective*, New York: IEEE Press, 2000, ISBN 0-7803-4723-4. \$133. [Strong EE orientation. This is apparently out of print, but you can find both new and used copies through online booksellers and a print-on-demand version (for \$190!) from the publisher.]

Malcolm H. Levitt, *Spin Dynamics: Basics of Nuclear Magnetic Resonance, Second Edition*, West Sussex: Wiley, 2008, ISBN 978-0-470-51117-6, \$91.50.

McRobbie DW, *Essentials of MRI Safety*, First Edition, Wiley-Blackwell, 2020, ISBN: 978-1-119-55717-3, \$70

Useful Web Sites

American Association of Physicists in Medicine, <http://www.aapm.org/>

American Institute of Ultrasound In Medicine, <https://www.aium.org/>

International Society for Magnetic Resonance in Medicine, <http://www.ismrm.org/>

Questions and Answers in MRI, <https://mriquestions.com/index.html>

MRISafety.com, <https://mrisafety.com/>