

Summer 2023 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) 10:00-11:30 p.m. Room CPB5.3312 (US) and FCT14.5059 (MR)
Labs:	Day, time, and location vary (TBD by coordinator and students)
Grading:	Ultrasound and MR units weighted equally. 80% exams + 20% participation/assignments

Course Schedule

	DATE	TITLE	INSTRUCTOR
1	05/16	Introduction to Ultrasound	Bouchard
2	05/18	Ultrasound Interactions with Tissue I	Bouchard
3	05/23	Ultrasound Interactions with Tissue II	Bouchard
4	05/25	Beamforming I	Bouchard
5	05/30	Beamforming II	Bouchard
6	06/01	Ultrasound Imaging I	Bouchard
7	06/06	Ultrasound Imaging II	Bouchard
8	06/08	Ultrasound Imaging Artifacts	Bouchard
9	06/13	Ultrasound Quality Assurance & Safety	Bouchard
10	06/15	Advanced Ultrasound Imaging	Bouchard
	06/20	Exam 1: Ultrasound Physics	Bouchard
11	06/22	Introduction to Magnetic Resonance	Stafford
12	06/27	Signal Generation & Contrast Concepts	Stafford
13	06/29	Pulse Sequences I	Stafford
	07/04	Independence Day	
14	07/06	Image Formation & Reconstruction I	Stafford
15	07/11	Signal, Contrast & Noise in MRI	Stafford
16	07/13	Pulse Sequences II	Stafford
17	07/18	Magnetization Preparation	Stafford
18	07/20	Functional & Physiological MRI	Stafford
	07/25	No Class Scheduled (AAPM)	
19	07/27	MR Hardware	Stafford
20	08/01	Troubleshooting, Artifacts & Quality Control	Stafford
21	08/03	Physics of MR Safety	Stafford
	08/07	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
 Christakis Constantinides, *Magnetic Resonance Imaging: The Basics*, Boca Raton: CRC Press, 2014, ISBN 978-1-4822-1731-5. ~\$75 **[CC in the readings above]**.
 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. [We have copies of the first edition in the physics library on CPB5.]

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.]

Suggested References

Richard Ansorge and Martin Graves, *The Physics and Mathematics of MRI*, San Rafael: Morgan & Claypool, 2016, ISBN 978-1-6817-4004-1, \$70. [Very good at what it covers.]

Yi Wang, *Principles of Magnetic Resonance Imaging: Physics Concepts, Pulse Sequences and Biomedical Applications*, 2015 printing, ISBN 978-1479350414, \$109. [BME orientation with very strong explanation of relaxation effects.]

C.-N. Chen and D.I. Hoult, *Biomedical Magnetic Resonance Technology*, Philadelphia: Institute of Physics Publishing, 1989, ISBN 0-85274-118-9.

Z.H. Cho, Joie P. Jones, and Manbir Singh, *Foundations of Medical Imaging*, New York: Wiley, 1993, ISBN 0-471-54573-2.

Rafael C. Gonzalez, and Richard E. Woods, *Digital Image Processing, 4th Edition*, Upper Saddle River, NJ: Pearson Prentice Hall, 2017, ISBN 978-0133356724, \$244.20.

R.C. Gonzalez, R.E. Woods and S.L. Eddins, *Digital Image Processing Using Matlab*, Upper Saddle River: Pearson Prentice Hall, 2004, ISBN 0-13-008519-X. (Out of print, see http://www.imageprocessingplace.com/DIPUM-2E/DIPUM2E-Out_of_Print.htm.)

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

Hans-J. Smith and Frank N. Ranallo, *A Non-Mathematical Approach to Basic MRI*, Madison: Medical Physics Publishing Corp., 1989, ISBN 0-944838-02-2.

Perry Sprawls, *Magnetic Resonance Imaging: Principles, Methods and Techniques*, Madison: Medical Physics Publishing Corp., 2000, ISBN 0-944838-97-9.

Useful Web Sites

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

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

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