

Fall 2020 GS02 1194: Introduction to Medical Physics IV
The Physics of Nuclear Medicine and Magnetic Resonance Imaging

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Course Web Site: <http://www.uthgsbsmedphys.org/GS02-0193/>

Lectures: Tuesdays and Thursdays, 3:00-4:30 p.m., Room CPB5.3312 (if possible, or else virtual)

Labs: The day of the week, the time of day, and the location vary (subject to pandemic rules)

Lecture	Lab	Date	Title	Reading	By
1		1 Sep	Course Overview & Characteristics of Digital Images	CSP 1, F, G, 15, 19	RW
2		3 Sep	Introduction to Magnetic Resonance	BB 12; CC 1, 2	JW
3		8 Sep	Bloch Equations and Contrast Mechanisms	BB 12; CC 3	AL
4		10 Sep	Basic Pulse Sequences	BB 12; CC 6	RW
	1	Lab	Bloch Eqn. Simulator & Pulse Sequences I		RW
5		15 Sep	Image Formation and Reconstruction I	BB 13; CC 4, 5	RW
6		17 Sep	Image Formation and Reconstruction II	BB 13; CC 4, 5	RW
	2	Lab	Bloch Eqn. Simulator & Pulse Sequences II		RW
7		22 Sep	SNR, CNR and More Pulse Sequences	BB 12, 13; CC 9	AL
8		24 Sep	MR Hardware	BB 13; CC 7, 8	JSt
9		29 Sep	Image Quality and Artifacts	BB 13	JY
	3	Lab	MR Image Resolution and Contrast		JY
10		1 Oct	MR Safety	BB 13; CC 7, 8	JSt
11		6 Oct	Review for the First Examination		RW
12		8 Oct	Radioactive Decay, Decay Modes, Interactions & Detection Review	CSP 2-4, 6-12; BB 15, 17	RW
13		13 Oct	Gamma Camera – Basics	CSP 13-14; BB 18	RW
		13 Oct	First Examination Due		
	4	Lab	Gamma Camera		WE, RW
14		15 Oct	Gamma Camera – Collimation	CSP 13-14	RW
15		20 Oct	Backprojection SPECT Reconstruction	CSP 16; BB 10	RW
	5	Lab	SPECT		WE, RW
16		22 Oct	Iterative SPECT Reconstruction	CSP 16; BB 10	WE
17		27 Oct	SPECT Applications	CSP 17; BB 19	WE
	6	Lab	Non-imaging Instrumentation	CSP 11; BB 17	WE, RW
18		29 Oct	Nuclear Medicine Quality Control	CSP 11, 14-15; BB 18-19	WE
19		3 Nov	Review for the Second Examination		RW
20		5 Nov	Radionuclide Production and Characteristics	CSP 3, 5; BB 16	RW
21		10 Nov	Positron Emission Tomography I	CSP 18; BB 19	OM
		10 Nov	Second Examination Due		
22		12 Nov	Positron Emission Tomography II	CSP 18; BB 19	OM
23		17 Nov	Positron Emission Tomography III	CSP 18; BB 19	OM
	7	Lab	PET and PET/CT		OM, TP
24		19 Nov	Hybrid Imaging	CSP 19; BB 19	TP
25		24 Nov	Internal Dosimetry – I	CSP 22; BB 16	RW
26		26 Nov	Thanksgiving Day Holiday		
27		1 Dec	Internal Dosimetry - II	CSP 22; BB 16	RW
		3 Dec	Radionuclide Therapy Treatment Planning	AAPM 71	WE
28		8 Dec	Radiopharmaceutical Chemistry	CSP 5; BB 16	JSi
	8	Lab	Internal Dosimetry and Therapy		WE, RW
29		10 Dec	Review for the Third Examination		RW
		18 Dec	Third Examination Due		

Presenters:

RW — Richard Wendt, Ph.D.
 OM — Osama Mawlawi, Ph.D.
 JSi — Jim Simon, Ph.D.

TP — Tinsu Pan, Ph.D.
 WE — William Erwin, M.S.
 AL — Anthony Liu, Ph.D.

JW — Jihong Wang, Ph.D.
 JSt — Jason Stafford, Ph.D.
 JY --- Joshua Yung, Ph.D.

Strongly Recommended Textbooks:

- Christakis Constantinides, *Magnetic Resonance Imaging: The Basics*, Boca Raton: CRC Press, 2014, ISBN 978-1-4822-1731-5. ~\$75 [CC in the readings above].
- Simon R. Cherry, James A. Sorenson and Michael E. Phelps, *Physics in Nuclear Medicine: Fourth Edition*, Philadelphia: W.B. Saunders, 2012, ISBN 978-1-4160-5198-5. ~\$130 [CSP in the readings above. The fourth has been significantly updated from previous editions.]
- Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, Jr., and John M. Boone, *The Essential Physics of Medical Imaging*, 3rd Ed., Philadelphia: Wolters Kluwer | Lippincott, Williams & Wilkins, 2011, ISBN 978-0781780575. ~\$212 [BB in the readings]
- Daniel J. Macey, et al., *A Primer for Radioimmunotherapy and Radionuclide Therapy: AAPM Report 71*, Madison: Medical Physics Publishing, 2001, ISBN 1-888340-29-0, \$15 or http://www.aapm.org/pubs/reports/rpt_71.pdf [AAPM 71 in the readings above.]

Other Useful Textbooks:

- Robert E. Henkin, et al., eds., *Nuclear Medicine*, St. Louis: Mosby, 1996, ISBN 0-8016-7701-7, Chapters 1-39 for basic science and others for clinical background. \$\$\$\$ [A newer edition is out and we have a copy of it in the physics library on CPB5.]
- 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.]
- 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:

- Radiation Safety Manual*, Radiation Safety Office, The University of Texas M. D. Anderson Cancer Center, 2017, <http://inside.mdanderson.org/departments/facilities/emergency-safety/files/radiation-safety-manual.pdf>.
- C.-N. Chen and D.I. Hout, *Biomedical Magnetic Resonance Technology*, Philadelphia: Institute of Physics Publishing, 1989, ISBN 0-85274-118-9.
- M.C. Cantone and C. Hoeschen, Eds., *Radiation Physics for Nuclear Medicine*, Heidelberg: Springer, 2011, ISBN 978-3-642-11327-7, \$174.
- Z.H. Cho, Joie P. Jones, and Manbir Singh, *Foundations of Medical Imaging*, New York: Wiley, 1993, ISBN 0-471-54573-2.
- Kristen M. Waterstram-Rich and David Gilmore, *Nuclear Medicine and PET/CT: Technology and Techniques*, 8th Ed., St. Louis: Elsevier, 2017, ISBN 978-0-323-35622-0, \$160. (Includes a technologist-level explanation of many NM procedures.)
- Keith F. Eckerman and Akira Endo, *MIRD: Radionuclide Data and Decay Schemes, 2nd Edition*, Reston: Society of Nuclear Medicine, 2008, ISBN 978-0-932004-2.
- 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.)
- Harold E. Johns and John R. Cunningham, *The Physics of Radiology: Fourth Edition*, Springfield: Thomas, 1983, ISBN 0-398-04669-7.
- Malcolm H. Levitt, *Spin Dynamics: Basics of Nuclear Magnetic Resonance, Second Edition*, West Sussex: Wiley, 2008, ISBN 978-0-470-51117-6, \$91.50.
- Robert Loevinger, et al., *MIRD Primer for Absorbed Dose Calculations, Revised Edition*, Reston: Society of Nuclear Medicine, 1991, ISBN 0-932004-38-5.
- James H. McClellan, Ronald W. Schafer, and Mark A. Yoder, *Signal Processing First: A Multimedia Approach*, Upper Saddle River, NJ: Pearson Education, 2003, ISBN 0-13-090999-8.
- Brian J. McParland, *Nuclear Medicine Radiation Dosimetry: Advanced Theoretical Concepts*, Dordrecht: Springer, 2011, ISBN 978-1-4419-9655-8.
- Jose Maria Perez and Javier Pascau, *Image Processing with ImageJ*, Birmingham, UK: Packt Publishing, 2013, ISBN 978-1783283958.
- Gopal B. Saha, *Fundamentals of Nuclear Pharmacy, Sixth Edition*, New York: Springer Verlag, 2010, ISBN 978-1441958594, \$110.
- 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.
- Donald Venes, Ed., *Taber's Cyclopedic Medical Dictionary, 22nd Edition*, Philadelphia: F.A. Davis, 1989, ISBN 978-0803629776.
- H. Zaidi, Ed., *Quantitative Analysis in Nuclear Medicine Imaging*, New York: Springer, 2006, ISBN 0-387-23854-9, \$134.

Useful Web Sites:

- Nuclear Medicine Physics Links, <http://www.uthgsbsmedphys.com/GS02-0193/WebInfo.html>
- International Society for Magnetic Resonance in Medicine, <http://www.ismrm.org/>
- Society of Nuclear Medicine and Molecular Imaging, <http://www.snm.org/>
- American Association of Physicists in Medicine, <http://www.aapm.org/>
- Health Physics Society, <http://www.hps.org/>