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, Cheryl Spitzenberger or Natalie Sirisaengtaksin. 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 Course Number and Course Title: **GS02 1194: Introduction to Medical Physics IV** Credit Hours: **4** Meeting Location: **Cancer Prevention Building** Building/Room#: **CPB5.3312** WebEx/Zoom Link: **TBD**	Program Required Course: **X** Yes No Approval Code: **X** Yes No **(If yes,** the Course Director or the Course Designee will provide the approval code.) Audit Permitted: **X** Yes No Classes Begin: **31 August 2021** Classes End: **9 December 2021** Final Exam Week: **13-17 December 2021**

Class Meeting Schedule

Day	Time
Tuesdays	**3:00-4:30 pm**
Thursdays	**3:00-4:30 pm**

Course Director Name and Degree: **Richard E. Wendt III, PhD** Title: Professor Department: **Imaging Physics** Institution: *UTH* **X** *MDACC* Email Address: rwendt@mdanderson.org Contact Number: **713-745-3250** Course Co-Director/s: (if any) Name and Degree: Title: Department: Institution: *UTH* *MDACC* Email Address: Contact Number:	**Instructor/s** (Use additional page as needed) 1. Name and Degree: **Tinsu Pan, PhD** Institution: MDACC Email Address : tpan@mdanderson.or g 2. Name and Degree: **Jihong Wang, PhD** Institution: MDACC Email Address: jihong.wang@mdanderson.org 3. Name and Degree: **Osama Mawlawi, PhD** Institution: MDACC Email Address: omalawi@mdanderson.org 4. Name and Degree: **William Erwin, MS** Institution: MDACC Email Address: werwin@mdanderson.org 5. Name and Degree: **Jason Stafford, PhD**

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

Teaching Assistant: (if any)

Name and Email Address

Name and Email Address

Institution: MDACC

Email Address: jstafford@mdanderson.org

6. Name and Degree: **Anthony Liu, PhD**
Institution: MDACC
Email Address: hlaliu@mdanderson.org

7. Name and Degree: **Joshua Yung, PhD**
Institution: MDACC
Email Address: jyung@mdanderson.org

8. Name and Degree: **Jaime (Jim) Simon, PhD**
Institution: IsoTherapeutics Group, LLC
Email Address: jimsimon@isotherapeutics.com

Course description:

This course presents the fundamental principles of nuclear medicine physics and magnetic resonance imaging physics.

Textbook/Supplemental Reading Materials

- Christakis Constantinides, *Magnetic Resonance Imaging: The Basics*, Boca Raton: CRC Press, 2014, ISBN 978-1-4822-1731-5. ~$75 [CC in the readings].
- 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. 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.]

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. Hoult, *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:

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/

Course Objective/s:

This course presents the fundamental principles of nuclear medicine physics and magnetic resonance imaging physics.

***Specific Learning Objectives*:**

1. To understand the fundamental principles of nuclear medicine physics and to apply them in basic clinical scenarios.

2. To understand the fundamental principles of magnetic resonance imaging physics and to apply them in simple clinical scenarios.

Student responsibilities and expectations: Students are expected to attend class meetings and in-person labs. The examinations are given as take-home exams and students are expected to follow the rules of the exams. Most of the labs can be worked on in teams, but unless it is stated that the reports may be team reports, each student should write his or her own report. Students are expected to read the readings prior to the lectures. Review problems are given at the beginning of the semester and students are expected to have worked through the questions for each exam, along with every worked example in the textbooks, prior to the in-class review session for that exam.

Grading System: **X** Letter Grade (A-F) Pass/Fail	
Student Assessment and Grading Criteria : Students' scores on the examinations, their reports of the labs, and their participation in discussions will be factored into their grades in a holistic fashion that determines how well they have understood the subject matter of the course.	
Homework (%)	Description
Quiz (%)	Description
Reports (%)	Description: **Most of the labs will include a report, the purpose of which is for the student to demonstrate his or her understanding of the point of the lab and his or her ability to address new problems with that understanding.**
Midterm Exams (%)	Description: **Three exams, each covering about a third of the course, will be given.**
Final Exam (%)	Description
Workshop or Breakout-Session (%)	Description
Participation and/or Attendance (%)	Description: **Students are encouraged to participate in classroom and laboratory discussions, and especially the review sessions for the examinations.**

CLASS SCHEDULE

Day/Date	Duration (Hr)	Lecture Topic	Reading	Lecturer/s
31 Aug	1.5	Course Overview & Characteristics of Digital Images	CSP 1, F, G, 15, 19	Wendt
2 Sep	1.5	Introduction to Magnetic Resonance	BB 12; CC 1,2	Wang
7 Sep	1.5	Bloch Equations and Contrast Mechanisms	BB 12; CC 3	Liu
9 Sep	1.5	Basic Pulse Sequences	BB 12; CC 6	Wendt
14 Sep	1.5	Image Formation and Reconstruction I	BB 13; CC 4.5	Wendt

16 Sep	1.5	Image Formation and Reconstruction II	BB 13; CC 4.5	Wendt
21 Sep	1.5	SNR, CNR, and More Pulse Sequences	BB 12, 13; CC 9	Liu
23 Sep	1.5	MR Hardware	BB 13; CC 7,8	Stafford
28 Sep	1.5	MR Image Quality and Artifacts	BB 13	Yung
30 Sep	1.5	MR Safety	BB 13; CC 7,8	Stafford
5 Oct	1.5	Review for Exam 1		Wendt
7 Oct	1.5	Radioactive Decay, Decay Modes, Interactions & Detection Review	CSP 2-4, 6-12; BB 15,17	Wendt
12 Oct	1.5	Gamma Camera Basics	CSP 13-14; BB 18	Wendt
14 Oct	1.5	Gamma Camera Collimation	CSP 13-14	Wendt
19 Oct	1.5	Backprojection SPECT Reconstruciton	CPS 16; BB 10	Wendt
21 Oct	1.5	Interaitve SPECT Reconstruction	CSP 16; BB 10	Erwin
26 Oct	1.5	SPECT Applications	CSP 17; BB 19	Erwin
28 Oct	1.5	Nuclear Medicine Quality Control	CSP 11, 14-15; BB 18-19	Erwin
2 Nov	1.5	Review for Exam 2		Wendt
4 Nov	1.5	Radionuclide Production and Characteristics	CSP 3,5; BB16	Wendt
9 Nov	1.5	Positron Emission Tomography I	CSP 18; BB 19	Mawlawi
11 Nov	1.5	Positron Emission Tomography II	CSP 18; BB 19	Mawlawi
16 Nov	1.5	Positron Emission Tomography III	CSP 18; BB 19	Mawlawi
18 Nov	1.5	Hybrid Imaging	CSP 19; BB 19	Pan
23 Nov	1.5	Internal Dosimetry I	CSP 22; BB 16	Wendt
30 Nov	1.5	Internal Dosimetry II	CSP 22; BB 16	Wendt
2 Dec	1.5	Radionuclide Therapy Treatment Planning	AAPM 71	Erwin
7 Dec	1.5	Radiopharmaceutical Chemistry	CSP 5; BB 16	Simon
9 Dec	1.5	Review for Exam 3		Wendt
Week of 6 Sep	2	Bloch Equation Simulation and Pulse Sequences Lab I		Wendt
Week of 13 Sep	2	Bloch Equation Simulation and Pulse Sequences Lab II		Wendt
Week of 27 Sep (pandemic permitting)	2	MR Image Resolution and Contrast Lab		Yung
Week of 11 Oct	2	Gamma Camera Lab		Erwin and Wendt

Week of 18 Oct	2	SPECT Lab		Erwin and Wendt
Week of 25 Oct	2	Non-imaging Instrumentation Lab		Erwin and Wendt
Week of 15 Nov	2	PET and PET/CT Lab		Malawi and Pan
Week of 6 Dec	2	Internal Dosimetry and Therapy Lab		Erwin and Wendt

NOTE: Provide other class information as needed.

jal/04.21