

Summer 2020

Advanced Diagnostic Radiological Physics

BME 6505; Section 7402; 3 Credits

CLASS MEETING INFO

9:30^{AM} -10:35^{AM} Tue/Wed/Thu; Via Zoom

INSTRUCTOR

Manuel Arreola, PhD (arream@radiology.ufl.edu); Office Hours by appointment

TEACHING ASSISTANT

Zahra Razi, M.S. (e=mail) Office Hours by appointment

DESCRIPTION

Basic physics of magnetic resonance, applications to imaging, modern approaches

PRE-REQUISITES

ENU 6657, Diagnostic Radiological Physics

OBJECTIVES

At the end of semester, students will have the basic knowledge of:

- The basic quantum mechanical description of the magnetic resonance phenomenon, including energy states & state transitions
- The basic classical (electromagnetic) description of the magnetic resonance phenomenon, including magnetization, precession and energy absorption
- The concepts of spin-lattice and spin-spin relaxation and the characteristic relaxation times T1 and T2
- Field inhomogeneities and the basic spin-echo sequence
- Carr-Purcell & multi-echo sequences
- Signal encoding for image reconstruction: gradients
- Selective-excitation, frequency and phase encoding gradients
- Gradient-recovered echo sequences
- K-space and Fourier reconstructions
- RARE and EPI sequences
- Inversion recovery and other saturation sequences
- MR spectroscopy, diffusion weighted diffusion sensor, functional MR Imaging & other modern techniques; RARE & EPI sequences
- Biological effects of MRI, safety issues in MRI
- Design of MR facilities
- ACR safety guidelines, TJC & ACR accreditation issues

REQUIRED TEXTBOOKS & SOFTWARE

Add new textbook info here, please

The Essential Physics of Medical Imaging by Bushberg, Seibert, Leidholdt Jr, and Boone; 3rd Edition

Other reading assignments will be provided

COURSE SCHEDULE

Date	Topic	Lecturer
Tuesday, May 12	QM description: Nuclear Energy States in a Static Magnetic Field	Arreola
Wednesday, May 13	QM description: Transitions between states; resonance	Arreola
Thursday, May 14	QM description: Alternating Fields and Free-Induction Decay; Larmor's equation	Arreola
Tuesday, May 19	Classical description: Equations of motion; Lab and Rotating Frames of Reference	Arreola
Wednesday, May 20	Classical description: Bloch's equations; Transverse and longitudinal magnetizations	Arreola
Thursday, May 21	Classical description: Spin-Lattice and Spin-Spin Relaxation Processes	Arreola
Tuesday, May 26	SE sequences: Static Field Inhomogeneities and the basic Spin Echo (SE) Sequence	Arreola
Wednesday, May 27	SE sequences: Measuring T1 and T2: Carr-Purcell and Inversion Recovery Sequences	Arreola
Thursday, May 38	SE sequences: T1, T2 and Proton Density Signals	Arreola
Tuesday, June 2	Review of Fourier Analysis, transforms and frequency domain	
Wednesday, June 3	Signal encoding: Magnetic Field Gradients and Selective Excitation for Slice Selection	
Thursday, June 4	Exam 1	
Tuesday, June 9	Signal encoding: Frequency encoding gradient – first dimension of k-space	Arreola
Wednesday, June 10	Signal encoding: Phase encoding gradient – second dimension of k-space	Arreola
Thursday, June 11	K-Space and Fourier Transforms for Image Reconstruction - Conceptual	Arreola
Tuesday, June 16	K-Space and Fourier Transforms for Image Reconstruction - Mathematical	Arreola
Wednesday, June 17	Populating k-space: SE sequences- single slice acquisitions	Arreola
Thursday, June 18	Populating k-space: multi-slice acquisitions; Rapid Acquisition (RARE) sequence	Arreola
<i>Tuesday, June 23</i>	<i>No Class - Summer Break</i>	<i>N/A</i>
<i>Wednesday, June 24</i>	<i>No Class - Summer Break</i>	<i>N/A</i>
<i>Thursday, June 25</i>	<i>No Class - Summer Break</i>	<i>N/A</i>
<i>Tuesday, June 30</i>	<i>No Class – Summer Break</i>	<i>N/A</i>
<i>Wednesday, July 1</i>	<i>No Class – Summer Break</i>	<i>N/A</i>
<i>Thursday, July 2</i>	<i>No Class – Summer Break</i>	<i>N/A</i>
Tuesday, July 7	GRE Sequences: Gradient Recovery Echo (GRE), Preparation and Saturation Sequences	Arreola
Wednesday, July 8	Contrast Agents in MRI	Arreola
Thursday, July 9	Echo-Planar (EPI) Sequence	
Tuesday, July 14	Imaging Blood in MRI: signal enhancement	Arreola
Wednesday, July 15	MR Angiography and Cardiac MRI	Arreola
Thursday, July 16	In-vivo MR Spectroscopy	Arreola
Tuesday, July 21	Exam 2	
Wednesday, July 22	Diffusion MR Imaging: Weighed (DWI) and Tensorial (DTI)	
Thursday, July 23	Functional MR Imaging	Arreola
Tuesday, July 28	MR Scanner components and Instrumentation	Arreola
Wednesday, July 29	MR Scanner components and Instrumentation	Arreola
Thursday, July 30	Biological Effects and safety concerns	Arreola
Tuesday, August 4	American College of Radiology (ACR) Safety guidelines: design of MR facilities	Arreola
Wednesday, August 5	American College of Radiology (ACR) Safety guidelines: design of MR facilities	Arreola
Thursday, August 6	ACR Accreditation program for MR Facilities	Arreola
Tuesday, August 11	ACR Accreditation program for MR Facilities	Arreola
Wednesday, August 12	Level I and Level II MRI Training Sessions	Arreola
Thursday, August 13	Exam 3	

ATTENDANCE POLICY; MAKE-UP POLICY

Students are expected to attend each class period. Periods which may be missed should be brought to the attention of the Instructor as far in advance of the class period as possible. In the event of an unexcused absence, it is the student's responsibility to obtain and review the material that was covered during that class period.

Excused absences must be consistent with university policies in the Graduate Catalog and require appropriate documentation:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>

Make-up assignments will only be considered for exceptional circumstances and will be implemented by the instructor on a case-by-case basis.

CLASS EXPECTATIONS

Class distractions such as cell phones and pagers are unacceptable. Students will ensure that any such devices that are brought into the classroom will be turned off, or operated in a silent mode, during the class period.

EVALUATION OF GRADES

Assignment	Total Points	Percentage of Final Grade
Homework	100	10%
Exam 1	100	30%
Exam 2	100	30%
Exam 3	100	30%
		Total: 100%

GRADING POLICY

Percent	Grade
93-100	A
90-92	A-
86-89	B+
83-85	B
80-82	B-
76-79	C+
73-75	C
70-72	C-
66-69	D+
63-65	D
60-62	D-
0 - 59	E

More information on UF grading policy may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

STUDENTS REQUIRING ACCOMMODATIONS

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565; <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

EVALUATIONS

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

UNIVERSITY HONESTY POLICY

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

SOFTWARE USE

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

STUDENT PRIVACY

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

CAMPUS RESOURCES

Health and Wellness

U Matter, We Care

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center

352-392-1575; <http://www.counseling.ufl.edu/cwc>

Sexual Assault Recovery Services (SARS)

352-392-1161; Student Health Care Center

University Police Department

352-392-1111 (or 911 for emergencies); <http://www.police.ufl.edu/>

Academic Resources

E-learning Technical Support

352-392-4357 (select option 2); learning-support@ufl.edu; <https://lss.at.ufl.edu/help.shtml>

Career Resource Center

Career assistance and counseling.

352-392-1601; Reitz Union; <https://www.crc.ufl.edu/>

Library Support

Various ways to receive assistance with respect to using the libraries or finding resources. <http://cms.uflib.ufl.edu/ask>

Teaching Center

General study skills and tutoring.

352-392-2010 or 352-392-6420; Broward Hall; <https://teachingcenter.ufl.edu/>

Writing Studio

Help brainstorming, formatting, and writing papers.

352-846-1138; 302 Tigert Hall; <https://writing.ufl.edu/writing-studio/>

Student Complaints Campus

https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf

On-Line Students Complaints

<http://www.distance.ufl.edu/student-complaint-process>