NEW YORK CITY COLLEGE OF TECHNOLOGY

Department of Radiologic Technology & Medical Imaging

RAD 3737 – MR Anatomy, Pathophysiology & Instrumentation (2 class hr, 2 lab hr; 3 cr)

Course Pre / Co-Requisites: Admission to the BS in Radiological Science

HYBRID COURSE OUTLINE/INSTRUCTIONAL OBJECTIVES

A Hybrid Course with Physics Chemistry Math Medicine and Engineering Contents Satisfies MRI Licensure Didactic Eligibility from ARRT Credentialing Board

INSTRUCTORS:
Lazar Fleysher, PhD (RAD 3737 Physics Theory & Lab Tutorial);
Subhendra Sarkar, PhD RT(R MR CT N) CNMT DABMP (RAD 3737 MRI Protocols & Clinical Methods Tutorial)

Mondays: **6-7:40 P Lecture (MR Theory & Exercises: Prof Fleysher)**
8-9:40 PM Clinical Problems, Protocols Tutorial (Prof Sarkar).

EMAIL ADDRESSES: **LFleysher@CityTech.CUNY.edu**
SSarkar@CityTech.CUNY.Edu

OFFICE HOURS: **Prof LF:** **TBD**
OFFICE HOURS: **Prof SS:** **M 3-6P; W 3-6P**

COURSE DESCRIPTION (*ARRT approved for taking Licensure Exam*):

Both normal and pathologic magnetic resonance (MR) specifc anatomy are reviewed. A thorough understanding of both normal and abnormal anatomy as they appear with and without MR contrast, to correlate with other MR courses and, to some extent, with other relevant modalities including CT, ultrasound and nuclear medicine. ***There is also a laboratory/tutorial component based on MR physics including how to adjust technical parameters, patient positioning, and operating and optimizing imaging equipment from major equipment manufacturers without direct physician interaction.***

PREREQUISITES: *Admission to BSRS program or Department approval*

MODE OF INSTRUCTION & TESTING:

- 25-30% materials will be presented and tested face to face (on pre-announced dates)
- Rest of the course will be on synchronous zoom platform
- Make up tests will be available only for legitimate reasons and may be slightly harder.

NOTICE TO STUDENTS:

Qualified students with disabilities, under applicable federal, state, and city laws, seeking reasonable accommodations or academic adjustments must contact The Center for Student Accessibility for information on CityTech's policy and procedures to obtain such services. Students with questions on eligibility or the need for temporary disability services should also contact the center at: The Center for Student Accessibility, 300 Jay street, room L-237 718- 260-5143. HTTP://www.citytech.cuny.edu/accessibility/

REQUIRED TEXT:

MRI for Picture to protons (2010/2017) by McRobbie, Martin, Moore, Prince

+ Other review articles/web resources (will be posted in Blackboard Contents).

Lecture Topics and Brief Outline (note optional prep month):

Dates	**Background Prep** *by Dr. Sarkar*	**Before semester starts: optional & useful**
	Mondays 6-9:40 (20 min break)	
1/11 Mon Prep/Optional	*Mathematics & Chemistry for MRI* *Remove confusion about physics & chemistry needed in this course*	*Physics: Nuclear Structure, What is spin.* *Chemistry: Periodic Table and MRI* *Precalculus: Trigonometric Functions in MRI*
1/19 Tues Prep/Optional	*Magnetic & Electric Materials in MRI* *Why MR safety is very hard & important*	*Briefly: Dia, Para, Ferromagnetism* *Ch 1 of MRI Text (advisement on RAD courses)*
1/26 Prep/Optional	*Last Prep Class* *Examples of MR Images, quality etc*	*Why-MRI Career, discussion.* *Introduce MR images from Text (Chap 3)*
Decide MR vs General or CT concentration (this course is useful for all but mandatory only for MR)	**Regular Lecture Column:** *by Dr. Sarkar and Dr Fleysher*	**Regular Lab/Tutorial Column:** *by Dr. Sarkar and Dr Fleysher*

2/1 **1st Class** **Introduction**	**Prof Fleysher:** MR Instrumentation **Dr Sarkar: MR Safety (wake up!!)** (Briefly use **Ch 9, 10) not on test**	**This is a Lab Tutorial** **Go through all images in class from Chap 3** **Next week 2/8 Quiz** (students comment on any image of teacher's choice from Chap 3: based on: attention/notes taken)
2/8 Mon	**Dr. Fleysher:** **Neuro/Body/Musculoskeletal methods** Spin Echo vs Gradient Echo basics **Dr. Sarkar:** Quality in MR images for Spin echo vs Gradient Echo-examples only	**Quiz 1 on Chap 3 Images** (1-2 min each student talks) **Tutorial:** pixel, resolution (2D, 3D voxels: **Chap 4)**
2/15 Mon	**Presidents Day: College Closed**	**VOE due by 2/18**
2/22	**Dr. Fleysher:** **T1 T2 T2* Physics basics: Chap 3, 8** **Dr Sarkar :** **Tissue SNR, CNR (T1 T2 T2* Chemistry)**	**Tutorial (only Dr Sarkar)** **:** Example images (T1 T2 T2* methods) Differences in tissue SNR, CNR for T1 T2 T2* based imaging methods **Chap 3, 8**
3/1	**Dr. Fleysher:** Gadolinium Contrast Physics Effects on T1 and T2 images **Dr Sarkar :** Gadolinium Contrast Chemistry & Biology	**Quiz 2:** on T1 T2 T2* Physics and Chemistry **Tutorial:** **Dr Sarkar:** Contrast Molecular Structures
3/8	**Dr. Fleysher: Phase & Frequency Encoding Gradients Chap 7**	**Tutorial:** Basic Pulse Sequences **Chap 7**
3/15 Mon **Review First**	**Test # 1** **(upto incl. 3/8 Lec + Tutorial materials)**	**Does not include prep materials from January** **No tutorial on 3/15 (discuss answers Test #1)**
3/22	**Dr. Fleysher:** 2D vs 3D: advantages of each **Dr Sarkar :** Clinical Image Examples/Comparison	**Quiz 3:** Phase Frequency swap **Tutorial**: When to use 3D and when 2D
3/29 Mon	**Spring Recess**	
4/5 Mon	**Dr. Fleysher** : Back to SE vs GRE-advanced: Fat suppression by Inversion	**Dr. Fleysher**: Physics of Positive vs Negative Contrast ; single vs triple dose- benefits/risks note: triple dose not used any more, why?

	Dr Sarkar : Compare Fat suppression by different methods on quality and applicable anatomy Utility in head vs body for different fat suppressions	**Dr Sarkar :** Chemistry of Gadolinium today vs iron Nanoparticles next generation of contrasts
4/12 Mon	**Dr. Fleysher**: Utility of strong vs weak magnet systems **Dr Sarkar :** MR Anatomy and Pathology: Quality difference that strong vs weak magnets make	**Tutorial by both**: Blood Brain Barrier (BBB) disruption in Brain for stroke & cancer
4/19 Mon Review First	**Test # 2 (upto incl. 4/12 Lec + Tutorial materials)**	**Materials covered only after Test # 1 No tutorial on 4/19 (discuss answers Test #2)**
4/26 Mon **Harder**	**Dr. Fleysher**: MR Diffusion Sequence and related Physics **Dr Sarkar :** Stroke imaging by diffusion methods	**Dr. Fleysher**: Diffusion difference in brain vs body **Dr. Sarkar**: Diffusion difference in stroke vs tumor
5/3 Mon **Harder**	**Dr. Fleysher**: MR Angio – TOF (2D vs 3D Angio) **Dr Sarkar :** Current & Future MRA trends	**Tutorial:** **Dr Sarkar:** Cardiac angiography Compare with CT and Digital subtraction angio
5/10 Mon	Breast and Prostate MR – Dynamic Contrast Enhancement (DCE) sequence	**Tutorial:** **Dr Sarkar:** Breast and Prostate tumor imaging
5/17	Comprehensive Review by both (3 hr)	**No tutorial on 5/17**
5/24 Mon	**FINAL Exam: 3 hr total time available**	**5/28 Grade Submission Deadline**

COURSE GRADING:

Four Quizzes	***20%***
Tests 1&2	***25+25%***
Final	***30%***

LATENESS & ABSENTEEISM POLICY: ***Lateness/absence should be kept to a minimum. The quiz and test materials cannot be obtained from a single textbook or a single source. Much of those will come from actual lectures and tutorials. Quizzes will always base on students discussing the learned MR images/MRI calculations and then orally presenting for 1-2 minutes.***

LETTER GRADES:

90 – 100	**A**
85 – 89.9	**A-**
75 – 84.9	**B+**
60 --70	**B**
50 – 59.9	**C**
40-49.9	**D and below 40 =F (both are not allowed for clearing the course for BSRS Degree)**

COMMUNICATIONS:

Make sure you have an active college email to receive and check announcements from Bb.

There may be additional reminders using Navigator text messages.

NEW YORK CITY COLLEGE OF TECHNOLOGY POLICY ON ACADEMIC INTEGRITY:

Students and all others who work with information, ideas, texts, images, music, inventions and other intellectual property owe their audience and sources accuracy and honesty in using, crediting, and citing sources. As a community of intellectual and professional workers, the college recognizes its responsibility for providing instruction in information literacy and academic integrity, offering models of good practice, and responding vigilantly and appropriately to infractions of academic integrity. Accordingly, academic dishonesty is prohibited in The City University of New York and at New York City College of Technology and is punishable by penalties, including failing grades, suspension, and expulsion. The complete text of the College policy on Academic Integrity may be found in the catalog.

COURSE OBJECTIVES & LEARNING OUTCOMES:

KNOWLEDGE:

Upon course completion, students will be able to:	Measurable Outcome
1. Demonstrate knowledge of a number of imaging techniques in MR and solve problems.	In classroom discussion assignments and in exams students will be able to discuss knowledge of a number of current imaging techniques.
2. Demonstrate knowledge of application of MR principles as expected in clinical setting.	In classroom discussions students will demonstrate knowledge of various principles of MR.
3. Demonstrate knowledge of the older and newer versions of MR advantages as the field historically developed.	General awareness is expected for imaging pathology and outcomes in MR scans..
4. Demonstrate functioning of various imaging hardware and software as related to MR for clinical situations.	The student will compare available hardware and software from main vendors.
5. Demonstrate knowledge related to future need and safety concerns about the MR imaging developments.	In the final exam, students will be able to demonstrate this in quantitative terms.

SKILLS:

Upon completion, students will be able to:	Measurable Outcome
1. Appreciate applications of these modalities to acute and chronic diseases usually diagnosed with MR.	Prior to Final exam, students will be able to prepare test questions for each other on most of the topics including the safety, merits and applicability of MR.
2. Identify, contact and utilize the appropriate governmental agency (local, state, or federal) to address specific safety concerns and quality control of these modalities.	By the end of the course students will learn imaging benefits/risk and obtain some ability to optimize protocols suitable for various anatomical parts.

VALUES:

Upon completion, students will be able to:	**Measurable Outcome**
1. Expand their views of thinking about MR imaging issues from local to global perspectives.	In the second half of course students will be able to identify and apply MR principles from a high degree of safety perspective.
2. Appreciate age specific patient needs during MR examinations.	Students will be able to learn the age-related specificity and sensitivity of these tools to ensure image gently is feasible and important.

MR General Education

Learning outcomes (Gen LO's)	**Assessment**
1. Understand and employ both qualitative and quantitative analysis to describe advanced sciences making progress against diseases.	Students will be tested through several quizzes both qualitative and quantitative importance of screening and management of diseases by advanced MR techniques.
2. Develop an in-depth appreciation of benefits and risks as related to large data and ultrafast medical technology.	On these topics' students will be assessed during class discussions on a regular basis as well as during Mid Term and Final exams.
3. Will be able to integrate expression of diseases at various ages, in different cultures, and the role of society in optimal healthcare.	Students will be evaluated during quizzes and other exams the age and culture related differences that need to be accommodated in MR applications

Learning outcomes and Assessments

Discipline specific

1. Will be able to assess MR image quality and incorporate the added quality from advanced MR methods and discuss with radiology managers and colleagues in the professional domain as needed.	These will be assessed by quizzes, Q&A synchronous presentations and class discussions. (This may be in addition or as substitute to mid-term and final exam formats).
2. Will compare the MR dose and contrast safety, efficacy and accuracy of various MR protocols in order to take leadership roles in MR suites or in team building as a lead technologist with multiple vendors and with a growing number of diagnostic applications.	These will be assessed by quizzes, Q&A synchronous presentations and class discussions. (This may be in addition or as substitute to mid-term and final exam formats).