Republic of Yemen

Ministry of Education & Higher Research

Council of Academic Accreditation & Quality Assurance of

Higher Education (CAQA)

21 septamber University of Medical and Applied Science

Faculty of Applied Medical Science

Department of Medical Radiology and Imaging Technology

Program of Radiologic Technology and Medical Imaging

Course Specification of

CT & MRI Physics

Course Code. (____)

2024

I. General Information:

1.	Course Title:	CT & MRI Physics				
2.	Course Code:					
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial/ Seminar	Lab	Clinical
		2	2	--	--	--
4.	Level/ Semester at which this Course is offered:	4th Level / 1st Semester				
5.	Pre –Requisite (if any):					
6.	Co –Requisite (if any):	None				
7.	Program (s) in which the Course is Offered:	Bachelor of Radiologic Technology and Medical Imaging				
8.	Language of Teaching the Course:	English				
9.	Location of Teaching the Course:	Faculty of Applied Medical Science				
10.	Prepared by:					
11.	Date and Number of Approval by Council:					

II. Course Description:

The CT & MRI Physics course is designed to provide students with the necessary knowledge and understanding of the principles and technologies used in computed tomography (CT) and magnetic resonance imaging (MRI). The course covers the physical principles, image formation techniques, and technologies behind both modalities, with a focus on their applications in medical diagnostics. Key topics include the principles of X-ray and magnetic field interaction, signal acquisition, image reconstruction, safety standards, and emerging technologies. The course emphasizes both the theoretical aspects of CT and MRI as well as practical knowledge needed to understand and operate these imaging systems safely and effectively.

III. Course Intended Learning Outcomes (CILOs) : Upon successful completion of the course, students will be able to:		Referenced PILOs		
A. Knowledge and Understanding:		**I, P or M/A**		
a1	Understand the basic physical principles behind CT and MRI technologies.	**M**	**A1**	Demonstrate and understanding of fundamental knowledge of Biomedical sciences (Biology, Biophysics, Anatomy, Physiology, Sectional anatomy and medical imaging technique).
a2	Describe the components of CT and MRI systems and their function in image formation.	**M**	**A2**	Explanation the principles and procedures of medical imaging acquisitions, medical imaging technique and Radiological Technology Sciences as well as patient positioning in computed radiography and MRI technique.
B. Intellectual Skills:				
b1	Analyze the interaction of X-rays and magnetic fields with matter in CT and MRI.	**M**	**B3**	Analyze and evaluate evidence-based information needed in medical imaging practice.
b2	Evaluate the quality of CT and MRI images and understand the factors affecting them.	**M**	**B2**	Devising solutions for positioning and instructing people throughout a procedure, as well as using the radiation safety protocols.
C. Professional and Practical kills:				
c1	Operate CT and MRI equipment and apply safety protocols.	**M**	**C2**	Apply technical skills using medical imaging devices, tools, and materials in radiological technology practice.
c2	Troubleshoot common technical problems encountered in CT and MRI imaging.	**M**	**C4**	Utilize appropriate manual and automated techniques in radiological imaging investigations

D. Transferable Skills:				
d1	Demonstrate problem-solving skills in real-world CT and MRI scenarios.	**M**	**D3**	Recognize the need to obtain further education in the pursuit of life-long learning.
d2	Communicate effectively within a healthcare setting regarding imaging procedures.	**M**	**D1**	Communicate effectively with clinicians, patients, and support staff.
I= Introduced, P=Practiced or M/A= Mastered/Advanced				

(A) Alignment of Course Intended Learning Outcomes (Knowledge and Understanding) to Teaching Strategies and Assessment Methods:			
Course Intended Learning Outcomes		**Teaching Strategies**	**Assessment Strategies**
a1	Understand the basic physical principles behind CT and MRI technologies.	▪ Lectures, diagrams, and animations illustrating CT and MRI physics.	▪ Written exams, quizzes.
a2	Describe the components of CT and MRI systems and their function in image formation.	▪ System demonstrations, hands-on practical sessions for equipment introduction.	▪ Written exams, quizzes.
(B) Alignment of Course Intended Learning Outcomes (Intellectual Skills) to Teaching Strategies and Assessment Methods:			
Course Intended Learning Outcomes		**Teaching Strategies**	**Assessment Strategies**
b1	Analyze the interaction of X-rays and magnetic fields with matter in CT and MRI.	▪ Case studies, discussions on interactions of X-rays and magnetic fields.	▪ Written exams, quizzes. ▪ Case study analysis,
b2	Evaluate the quality of CT and MRI images and understand the factors affecting them.	▪ Image quality analysis, exercises on identifying and resolving image artifacts.	▪ Written exams, quizzes. ▪ Image analysis assignments
(C) Alignment of Course Intended Learning Outcomes (Professional and Practical Skills) to Teaching Strategies and Assessment Methods:			
Course Intended Learning Outcomes		**Teaching Strategies**	**Assessment Strategies**

c1	Operate CT and MRI equipment and apply safety protocols.	▪ Lecture sessions for CT and MRI operation.	▪ Written exams, quizzes, assignments
c2	Troubleshoot common technical problems encountered in CT and MRI imaging.	▪ Troubleshooting sessions, solving imaging issues.	▪ Written exams, quizzes, Case study assignments

(D) Alignment of Course Intended Learning Outcomes (Transferable Skills) to Teaching Strategies and Assessment Methods:

Course Intended Learning Outcomes		Teaching Strategies	Assessment Strategies
d1	Demonstrate problem-solving skills in real-world CT and MRI scenarios.	▪ Group discussions and problem-solving tasks.	▪ Group projects, written assignments.
d2	Communicate effectively within a healthcare setting regarding imaging procedures.	▪ Role-playing scenarios for communication with patients and medical staff.	▪ Assignments.

IV. Course Contents:

A. Theoretical Aspect:

No.	Title	Sup-title	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Introduction to CT and MRI Physics**	– Basic principles of CT and MRI, Overview of the technologies	1	2	a1, a2
2	**The Physics of X-rays in CT Imaging**	– X-ray generation, attenuation, CT imaging modalities	1	2	a1, b1
3	**MRI Physics: Basic Principles**	– Magnetic fields, radiofrequency pulses, relaxation processes	1	2	a1, a2
4	**CT Image Formation and Reconstruction**	– Data acquisition, image reconstruction algorithms	1	2	a2, b2
5	**MRI Image Formation and Signal Acquisition**	– Fourier transform, k-space, MRI scanners	1	2	a2, b2

No.	Title	Sup-title	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
6	**CT Scanning Parameters and Image Quality**	– Slice thickness, pitch, resolution, contrast	1	2	b1, b2
7	**MRI Scanning Parameters and Image Quality**	– Echo time (TE), repetition time (TR), signal-to-noise ratio	1	2	b1, b2
8	**Mid-term Exam**	– All Previous topics	1	2	a1, a2, b1, b2, c1, c2
9	**Radiation Dose and Safety in CT Imaging**	– Dose reduction techniques, radiation protection protocols	1	2	a1, c1
10	**MRI Safety Considerations**	– Magnetic field safety, patient safety during MRI scans	1	2	a2, c1
11	**Advanced CT Imaging Techniques**	– Multislice CT, spiral/helical scanning, CT angiography	1	2	a2, b1
12	**Advanced MRI Imaging Techniques**	– Functional MRI, Diffusion Tensor Imaging (DTI), MR spectroscopy	1	2	a2, b1
13	**Image Artifacts in CT and MRI**	– Types of artifacts in CT and MRI, artifact correction methods	1	2	b2
14	**CT and MRI in Clinical Applications**	– Applications in neurology, cardiology, musculoskeletal imaging	1	2	b1, c2
15	**Future Trends in CT and MRI Technology**	– Emerging technologies, hybrid imaging, AI in imaging	1	2	a1, b2
16	**Final Exam**	– All topics	1	2	a1, a2, b1, b2, c1, c2
Number of Weeks /and Units Per Semester			**16**	**32**	

B. Practical Aspect (Lab/Clinical) (if any):

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**None**			

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
2				
Number of Weeks /and Units Per Semester				

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	None			
2				
3				
Number of Weeks /and Units Per Semester				

VII. Teaching Strategies:

- Lectures and Visual Aids
- Case Studies and Image Analysis
- Interactive Simulations
- Discussions and Problem-Solving

VII. Assessment Methods:

- Written Exams
- Quizzes
- Assignments
- Case Study Reports

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	Case Study	Week 10	10	D1, B1
2	--			

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
Total			10	

VIII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	**Mid-term Exam**	Week 7	20	20%	a1, a2, b1
2	**Case Study Report**	Week 10	10	10%	b1, b2, c1, c2, d1. d2
3	**Final Exam**	Week 14	70	70%	a1, b1, b2
Total			**100**	**100 %**	

IX. Learning Resources:

1- Required Textbook(s) (maximum two):

1- Sachin Khanduri, 2018, Textbook Of Radiology For Ct And Mri Technicians With Mcqs, Jaypee Brothers Medical Publishe.
2- Wells Mangrum MD, Quoc Bao Hoang MD, Tim J Amrhein MD, 2018, Duke Review of MRI Physics: Case Review, 2nd Edition, Elsevier

2- Essential References:

1- Stephen J. Powers, 2021, MRI Physics: Tech to Tech Explanations 1st Edition, Wiley-Blackwell
2- John H. Harris Jr., William H. Harris, 2013, Radiology of emergency medicine [digital], 5th ed., Philadelphia, Wolters Kluwer Health/Lippincott Williams & Wilkins.
3- Catherine Westbrook, John Talbot, 2018, MRI in Practice, 5th Edition, Wiley-Blackwell
4- Donald W. McRobbie, 2020, Essentials of MRI Safety 1st Edition, Wiley-Blackwell.
5- Walter Huda MD, 2016, Review of Radiologic Physics, Fourth Edition, LWW.

3- Electronic Materials and Web Sites etc.:

Electronic Materials and Websites

- Radiologic and MRI Technologists: Guide to Education and Certification, https://www.2xdegree.com/degree/radiologic-and-mri-technologists
- www.mriphysics.org
- www.ctimaging.com

X. Course Policies: (Based on the Uniform Students' By law (2007)	
1	**Class Attendance:** Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.
2	**Tardiness:** A student will be considered late if he/she is not in class after 10 minutes of the start time of class.
4	**Assignments & Projects:** Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.
5	**Cheating:** Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.
6	**Forgery and Impersonation:** Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply**.**
7	**Other policies:** The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration.
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Faculty of Medical Technology

الجمهورية اليمنية
وزارة التربية والتعليم والبحث العلمي
جامعة 21 سبتمبر للعلوم الطبية والتطبيقية
كلية التكنولوجيا الطبية

Faculty of Applied Medical Science

Department of Medical Radiology and Imaging Technology

Program of Radiologic Technology and Medical Imaging

Course Plan (Syllabus) of

CT & MRI Physics

Course Code. .....

I. Information about Faculty Member Responsible for the Course:								
Name of Faculty Member:		Office Hours						
Location& Telephone No.:	-----							
E-mail:	--@--.--	SAT	SUN	MON	TUE	WED	THU	

2024/2025

Prepared by:	Reviewed by:	Head of the Department:	Quality Unit:	Dean:
	Dr. -----	Dr. Awadh Al-Kubati	Dr. Mohammed Al-shamahi	Dr. Abdulsalam Dalaq

I. General Information:

12.	**Course Title:**	CT & MRI Physics				
13.	**Course Code:**					
14.	**Credit Hours:**	**Credit Hours**	**Theory Contact Hours**		**Practical Contact Hours**	
			Lecture	**Tutorial/ Seminar**	**Lab**	**Clinical**
		2	2	--	--	--
15.	**Level/ Semester at which this Course is offered:**	4^{th} Level / 1^{st} Semester				
16.	**Pre –Requisite (if any):**					
17.	**Co –Requisite (if any):**	None				
18.	**Program (s) in which the Course is Offered:**	Bachelor of Radiologic Technology and Medical Imaging				
19.	**Language of Teaching the Course:**	English				
20.	**Location of Teaching the Course:**	Faculty of Applied Medical Science				
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22.	**Date and Number of Approval by Council:**					

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Upon successful completion of the course, students will be able to:

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c1	Operate CT and MRI equipment and apply safety protocols.
c2	Troubleshoot common technical problems encountered in CT and MRI imaging.
	D. Transferable Skills:
d1	Demonstrate problem-solving skills in real-world CT and MRI scenarios.
d2	Communicate effectively within a healthcare setting regarding imaging procedures.

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A. Theoretical Aspect:

No.	Title	Sup-title	Number of Weeks	Contact Hours
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3	**MRI Physics: Basic Principles**	– Magnetic fields, radiofrequency pulses, relaxation processes	1	2
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Number of Weeks /and Units Per Semester			**16**	**32**

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No.	Tasks/ Experiments	Number of Weeks	Contact Hours
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2			
Number of Weeks /and Units Per Semester			

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours
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