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

Radiation Physics 1

Course Code. (____)

2024

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:

1.	Course Title:	Radiation Physics 1				
2.	Course Code:					
3.	Credit Hours:	Credit Hours	Theory Contact Hours		Practical Contact Hours	
			Lecture	Tutorial/ Seminar	Lab	Clinical
		3	2	--	2	--
4.	Level/ Semester at which this Course is offered:	2nd Level / 1st Semester				
5.	Pre –Requisite (if any):	Biophysics				
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:

This course provides a comprehensive understanding of the principles and applications of radiation physics in medical imaging and therapy. Topics include atomic structure, interaction of radiation with matter, radiation detection, dosimetry, and quality assurance in radiology. Emphasis is placed on theoretical concepts and practical applications in radiological practice.

III. Course Intended Learning Outcomes (CILOs) :	Referenced PILOs

Upon successful completion of the course, students will be able to:				
	A. Knowledge and Understanding:	**I, P or M/A**		
a1	Explain the basic physiological mechanisms of major body systems	**I**	**A1**	Demonstrate an understanding of fundamental knowledge of Biomedical sciences (Biology, Biophysics, Anatomy, Physiology, Sectional anatomy and medical imaging technique).
a2	Describe the interrelationships between different physiological systems	**I**		
	B. Intellectual Skills:			
b1	Evaluate physiological data critically	**I**	**B3**	Analyze and evaluate evidence-based information needed in medical imaging practice.
b2	Formulate clinical interpretations based on advanced physiological principles	**I**	**B1**	Assessment the radiation exposure times and intensity of exposure to guarantee the imaging technique is accurate to reduce the risk factors and adapt to patient needs.
	C. Professional and Practical kills:			
c1	Conduct advanced physiological measurements and experiments	**I**	**C2**	Apply technical skills in using medical imaging devices, tools, and materials in radiological technology practice.
c2	Integrate physiological knowledge with radiologic and diagnostic techniques	**I**	**C4**	Utilize appropriate manual and automated techniques in radiological imaging investigations.
	D. Transferable Skills:			
d1	Present physiological concepts and data effectively	**I**	**D1**	Communicate effectively with clinicians, patients, and support staff.
d2	Collaborate efficiently in a multidisciplinary healthcare team	**I**	**D4**	Function effectively as an individual, as a member, or leader of a team engaged in appropriate activities to the radiologic

				technology disciplines to accomplish a common goal.

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	Explain the fundamental principles of radiation physics.	▪ Lectures, Demonstrations	▪ Written Exams, Quizzes
a2	Describe the interaction of radiation with matter.	▪ Case Studies, Group Discussions	▪ Assignments, Practical Exams

(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 radiological images using principles of radiation physics.	▪ Problem-Based Learning, Tutorials	▪ Lab Reports, Case Study Analysis
b2	Evaluate radiation dose calculations and safety measures.	▪ Workshops, Simulations	▪ Research Projects, Midterm Exams

(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	Perform radiation measurements and quality assurance tests.	▪ Hands-On Training, Lab Sessions	▪ Practical Exams, Skill Assessments
c2	Apply radiation protection principles in clinical practice.	▪ Role-Playing Exercises, Field Visits	▪ Oral Exams, Scenario-Based Assessments

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

	Course Intended Learning Outcomes	Teaching Strategies	Assessment Strategies
d1	Communicate complex radiation physics concepts clearly.	▪ Presentations	▪ Oral Presentations, Written Reports

d2	Apply problem-solving skills in radiation-related scenarios.	▪ Case Studies, Problem-Solving Tasks	▪ Assessments

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Atomic Structure and Radioactivity**	– Atomic Models, Radioactive Decay	1	2	a1, a2
2	**Interaction of Radiation with Matter**	– Photoelectric Effect, Compton Scattering	1	2	a1, a2
3	**Radiation Detection Methods**	– Geiger-Mueller Counters, Scintillation Detectors	1	2	a1, b1
4	**Dosimetry and Radiation Measurement**	– Absorbed Dose, Exposure	1	2	a1, b1, c1
5	**Radiographic Imaging Principles**	– X-ray Production, Attenuation	1	2	a1, a2, b1
6	**Computed Tomography (CT) Principles**	– Image Reconstruction, Hounsfield Units	1	2	a1, a2, b1
7	**Magnetic Resonance Imaging (MRI) Basics**	– Nuclear Magnetic Resonance, Image Formation	1	2	a1, a2, b1
8	**Mid-Term Exam**	– In all previous Topics	1	2	a1, a2, b1
9	**Ultrasound Physics**	– Sound Waves, Doppler Effect	1	2	a1, a2, b1
10	**Nuclear Medicine Imaging Principles**	– Radioisotopes, Gamma Cameras	1	2	a1, a2, b1
11	**Radiation Therapy Basics**	– Treatment Planning, Brachytherapy	1	2	a1, a2, b1, c1

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
12	**Quality Assurance in Radiology**	– Equipment Calibration, Image Artifacts	1	2	a1, a2, b1, c1
13	**Radiation Protection and Safety**	– ALARA Principle, Shielding	1	2	a1, a2, b1, c1
14	**Regulatory Aspects in Radiation Physics**	– Radiation Safety Standards, Compliance	1	2	a1, a2, b1, c1
15	**Emerging Technologies in Radiological Physics**	– AI in Radiology, Advanced Imaging Techniques	1	2	a1, a2, b1, b2, c1, c2
16	**Final Theoretical Exam**	– All theoretical 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	Radiation Detection Experiment: Geiger-Mueller Counters, Scintillation Detectors	1	2	a1, b1
2	Dosimetry Calculation Assignment: Radiation Dosimetry, Calculation Methods	1	2	a1, b1, c1
3	Radiographic Imaging Practice: X-ray Techniques, Image Quality Assessment	1	2	a1, a2, b1
4	CT Image Reconstruction Lab: Image Processing, Hounsfield Unit Calibration	1	2	a1, a2, b1
5	MRI Signal Acquisition Simulation: Magnetic Resonance Phenomenon, Pulse Sequences	1	2	a1, a2, b1

No.	Tasks/ Experiments	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
6	Ultrasound Imaging Workshop: Transducer Technology, Image Formation	1	2	a1, a2, b1
7	Radioisotope Handling Exercise: Radiopharmaceuticals, Radiation Safety	1	2	a1, a2, b1, c1
8	Treatment Planning Case Study: Radiation Therapy Techniques, Patient Safety	1	2	a1, a2, b1, c1
9	Quality Control Testing: Equipment Performance Evaluation, QA Procedures	1	2	a1, a2, b1, c1
10	Radiation Protection Scenario: Emergency Response, Personnel Safety	1	2	a1, a2, b1, c1
15	Final Practical Exam	1	2	a1, a2, b1, c1
Number of Weeks /and Units Per Semester		**14**	**28**	

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**
- **Demonstrations**
- **Case Studies**
- **Problem-Based Learning**
- **Hands-On Training**
- **Role-Playing Exercises**
- **Field Visits**

VII. Assessment Methods:

- **Written Exams**
- **Practical Exams**
- **Assignments**
- **Case Study Analysis**
- **Oral Presentations**
- **Research Projects**
- **Scenario-Based Assessments**

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1	**Radiation Physics Report**	Week 4	**2**	a1, b1, c1
2	**Dosimetry Calculation Assignment**	Week 7	**2**	a1, b1, c1
3	**Image Analysis Project**	Week 10	**3**	a1, a2, b1, c1
4	**Regulatory Compliance Presentation**	Week 12	**3**	a1, a2, b1, c1
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	**Midterm Written Exam**	Week 8	10	10%	a1, a2, b1, b2
2	**Final Practical Exam**	Week 9	30	30%	a1, a2, b1, c1
3	**Assignments**	During semester	10	10%	a1, a2, b2, c2, d2
4	**Final Written Exam**	Week 16	50	50%	a1, a2, b1, b2, c1, c2
Total			**100**	**100 %**	

IX. Learning Resources:

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

1. Ken Holmes, Marcus Elkington, Phil Harris, 2021, Clark's Essential Physics in Imaging for Radiographers, CRC Press, London.
2. Ervin B. Podgorsak, 2016, Radiation Physics for Medical Physicists, Springer.

2- Essential References:

1. Frank Herbert Attix, 2008, Introduction to Radiological Physics and Radiation Dosimetry, Wiley & Sons, Incorporated, John.
2. William R. Hendee, E. Russell Ritenour, 2003, Medical Imaging Physics, Wiley.
3. Ehsan Samei, Donald J Peck,, 2019, Hendee's Physics of Medical Imaging, John Wiley & Sons, Inc.
4. Mary Alice Statkiewicz Sherer, Paula J. Visconti, E. Russell Ritenour, Kelli Welch Haynes, 2017, Radiation Protection in Medical Radiography, Elsevier Health Sciences.

3- Electronic Materials and Web Sites etc.:

Electronic Materials and Websites

- American Association of Physicists in Medicine (AAPM)
- Radiological Society of North America (RSNA)

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.

3	**Exam Attendance/Punctuality:** No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed.

Faculty of Applied Medical Science

Department of Medical Radiology and Imaging Technology

Program of Radiologic Technology and Medical Imaging

Course Plan (Syllabus) of

Radiation Physics 1

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:**	Radiation Physics 1				
13.	**Course Code:**					
14.	**Credit Hours:**	**Credit Hours**	**Theory Contact Hours**		**Practical Contact Hours**	
			Lecture	**Tutorial/ Seminar**	**Lab**	**Clinical**
		3	2	--	2	--
15.	**Level/ Semester at which this Course is offered:**	2nd Level / 1st Semester				
16.	**Pre –Requisite (if any):**	Biophysics				
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				
21.	**Prepared by:**					
22.	**Date and Number of Approval by Council:**					

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III. Course Intended Learning Outcomes (CILOs) :
Upon successful completion of the course, students will be able to:

	A. Knowledge and Understanding:
a1	Explain the basic physiological mechanisms of major body systems
a2	Describe the interrelationships between different physiological systems
	B. Intellectual Skills:
b1	Evaluate physiological data critically
b2	Formulate clinical interpretations based on advanced physiological principles
	C. Professional and Practical kills:
c1	Conduct advanced physiological measurements and experiments
c2	Integrate physiological knowledge with radiologic and diagnostic techniques
	D. Transferable Skills:
d1	Present physiological concepts and data effectively
d2	Collaborate efficiently in a multidisciplinary healthcare team

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Atomic Structure and Radioactivity**	– Atomic Models, Radioactive Decay	1	2
2	**Interaction of Radiation with Matter**	– Photoelectric Effect, Compton Scattering	1	2
3	**Radiation Detection Methods**	– Geiger-Mueller Counters, Scintillation Detectors	1	2
4	**Dosimetry and Radiation Measurement**	– Absorbed Dose, Exposure	1	2
5	**Radiographic Imaging Principles**	– X-ray Production, Attenuation	1	2

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
6	**Computed Tomography (CT) Principles**	– Image Reconstruction, Hounsfield Units	1	2
7	**Magnetic Resonance Imaging (MRI) Basics**	– Nuclear Magnetic Resonance, Image Formation	1	2
8	**Mid-Term Exam**	– In all previous Topics	1	2
9	**Ultrasound Physics**	– Sound Waves, Doppler Effect	1	2
10	**Nuclear Medicine Imaging Principles**	– Radioisotopes, Gamma Cameras	1	2
11	**Radiation Therapy Basics**	– Treatment Planning, Brachytherapy	1	2
12	**Quality Assurance in Radiology**	– Equipment Calibration, Image Artifacts	1	2
13	**Radiation Protection and Safety**	– ALARA Principle, Shielding	1	2
14	**Regulatory Aspects in Radiation Physics**	– Radiation Safety Standards, Compliance	1	2
15	**Emerging Technologies in Radiological Physics**	– AI in Radiology, Advanced Imaging Techniques	1	2
16	**Final Theoretical Exam**	– All theoretical topics	1	2
Number of Weeks /and Units Per Semester			**16**	**32**

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

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
1	Radiation Detection Experiment: Geiger-Mueller Counters, Scintillation Detectors	1	2
2	Dosimetry Calculation Assignment: Radiation Dosimetry, Calculation Methods	1	2

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
3	Radiographic Imaging Practice: X-ray Techniques, Image Quality Assessment	1	2
4	CT Image Reconstruction Lab: Image Processing, Hounsfield Unit Calibration	1	2
5	MRI Signal Acquisition Simulation: Magnetic Resonance Phenomenon, Pulse Sequences	1	2
6	Ultrasound Imaging Workshop: Transducer Technology, Image Formation	1	2
7	Radioisotope Handling Exercise: Radiopharmaceuticals, Radiation Safety	1	2
8	Treatment Planning Case Study: Radiation Therapy Techniques, Patient Safety	1	2
9	Quality Control Testing: Equipment Performance Evaluation, QA Procedures	1	2
10	Radiation Protection Scenario: Emergency Response, Personnel Safety	1	2
15	Final Practical Exam	1	2
Number of Weeks /and Units Per Semester		**11**	**22**

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours
1	**None**		
2			
3			
Number of Weeks /and Units Per Semester		10	**20**

VII. Teaching Strategies:

- **Lectures**

- **Demonstrations**
- **Case Studies**
- **Problem-Based Learning**
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Total			**10**

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1	**Midterm Written Exam**	Week 8	10	10%
2	**Final Practical Exam**	Week 9	30	30%
3	**Assignments**	During semester	10	10%

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Total			**100**	**100 %**

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