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

Nuclear Medicine Physics

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:**	Nuclear Medicine 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:**	3rd Level / 2nd Semester				
5.	**Pre –Requisite (if any):**	CT & MRI Physics				
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:

Nuclear Medicine Physics provides an in-depth exploration of the principles of nuclear physics as applied to medical imaging and therapy. The course focuses on the physics underlying nuclear medicine imaging techniques such as Single Photon Emission Computed Tomography (SPECT) and Positron Emission Tomography (PET). Key topics include radiation physics, radiopharmaceuticals, instrumentation, image formation, quality assurance, and radiation protection. This course is designed to equip students with theoretical knowledge essential for understanding nuclear medicine practices, ensuring effective diagnostics, and maintaining safety standards.

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 fundamental principles of nuclear physics applied to nuclear medicine.	**I**	**A1**	Demonstrate and understanding of fundamental knowledge of Biomedical sciences (Biology, Biophysics, Anatomy, Physiology, Sectional anatomy and medical imaging technique).
a2	Describe the properties and behavior of radiopharmaceuticals used in diagnostic and therapeutic procedures	**I**	**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 radiation with matter and its implications in medical imaging.	**I**	**B3**	Analyze and evaluate evidence-based information needed in medical imaging practice.
b2	Evaluate the performance of nuclear medicine equipment and its impact on image quality and patient safety	**I**	**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	Explain the operation of key nuclear medicine instruments, including gamma cameras and PET scanners.	**I**	**C2**	Apply technical skills using medical imaging devices, tools, and materials in radiological technology practice.
c2	Apply theoretical principles of radiation protection in nuclear medicine settings	**I**	**C4**	Utilize appropriate manual and automated techniques in radiological imaging investigations
D. Transferable Skills:				

d1	Demonstrate problem-solving skills in the context of nuclear medicine imaging	**P**	**D3**	Recognize the need to obtain further education in the pursuit of life-long learning.
d2	Communicate effectively with interdisciplinary teams regarding nuclear medicine protocols and safety	**P**	**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 fundamental principles of nuclear physics applied to nuclear medicine.	▪ Lectures on nuclear physics principles and applications.	▪ Written exams, quizzes.
a2	Describe the properties and behavior of radiopharmaceuticals used in diagnostic and therapeutic procedures	▪ Discussions on radiopharmaceuticals and their clinical roles.	▪ Written reports.
(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 radiation with matter and its implications in medical imaging.	▪ Case study analysis of radiation-matter interactions.	▪ Case study reports.
b2	Evaluate the performance of nuclear medicine equipment and its impact on image quality and patient safety	▪ Lectures on equipment performance and quality standards.	▪ Written 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	Explain the operation of key nuclear medicine instruments,	▪ Illustrative examples and video demonstrations of	▪ Written exams.

	including gamma cameras and PET scanners.	nuclear medicine equipment.	
c2	Apply theoretical principles of radiation protection in nuclear medicine settings	▪ Lectures on radiation protection principles.	▪ Written 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 the context of nuclear medicine imaging	▪ Problem-solving exercises and case analyses.	▪ Group discussions, reports.
d2	Communicate effectively with interdisciplinary teams regarding nuclear medicine protocols and safety	▪ Role-play scenarios for team communication.	▪ Reports.

IV. Course Contents:

A. Theoretical Aspect:

No.	Title	Sup-title	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**Introduction to Nuclear Medicine Physics**	– Overview of nuclear physics, history of nuclear medicine	1	2	a1, a2
2	**Radiation and Matter Interaction**	– Types of radiation, interactions with tissues, radiation absorption	1	2	b1
3	**Radiation Detection Techniques**	– Scintillation detectors, ionization chambers, dosimetry	1	2	a2, b1
4	**Radiopharmaceuticals: Types and Applications**	– Diagnostic and therapeutic radiopharmaceuticals	1	2	a2, b1
5	**Gamma Camera and PET Scanner Physics**	– Components, working principles, image formation in SPECT/PET	2	4	c1, a1

No.	Title	Sup-title	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
6	**Image Reconstruction and Processing**	– Mathematical modeling, Fourier transform, filter techniques	2	4	b2
7	**Mid-term Exam**	– All Previous topics	1	2	a1, a2, b1, b2, c1, c2
8	**Nuclear Medicine Instrumentation**	– Performance characteristics, calibration, error analysis	2	4	c1
9	**Quality Assurance in Nuclear Medicine**	– Routine checks, image quality standards, troubleshooting	2	4	b2, c1
10	**Radiation Protection and Safety**	– Safety protocols, shielding, radiation exposure limits	2	4	c2
11	**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**			
2				
Number of Weeks /and Units Per Semester		**11**	**22**	

C. Tutorial Aspect (if any):

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	**None**			
2				
3				

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

VII. Teaching Strategies:

- Lectures
- Case Studies
- Group Discussions
- Multimedia Resources

VII. Assessment Methods:

- Written Exams
- Quizzes
- Reports
- Participation

VII. Assignments:

No.	Assignments	Week Due	Mark	Aligned CILOs (symbols)
1				
2				
3				
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 8	15	15%	a1, a2, b1
2	Quizzes	Various	5	5%	a1, a2

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
	Case Study Report	Week 10	10	10%	b2, d1
3	**Final Exam**	Week 16	70	70%	a1, b1, b2
Total			**100**	**100 %**	

IX. Learning Resources:

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

1- Bailey, D. L.; Humm, J. L.; Todd-Pokropek, A.; Aswegen, A. van, 2014, Nuclear Medicine Physics: A Handbook for Teachers and Students, International Atomic Energy Agency,
2- Simon R. Cherry, James A. Sorenson, Michael E. Phelps, 2012, Physics in Nuclear Medicine, Elsevier Health Sciences.

2- Essential References:

1- Laura Harkness-Brenna, 2023, An Introduction to the Physics of Nuclear Medicine, Second Edition, IOP Publishing, Bristol, UK
2- Magdy M. Khalil, 2011, Basic Sciences of Nuclear Medicine, Springer

3- Electronic Materials and Web Sites etc.:

Electronic Materials and Websites

- www.nuclear-medicine.org
- www.radiologyinfo.org

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

Nuclear Medicine 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:

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13.	**Course Code:**					
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			Lecture	**Tutorial/ Seminar**	**Lab**	**Clinical**
		2	2	--	--	--
15.	**Level/ Semester at which this Course is offered:**	3rd Level / 2nd Semester				
16.	**Pre –Requisite (if any):**	CT & MRI Physics				
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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III. Course Intended Learning Outcomes (CILOs) :
Upon successful completion of the course, students will be able to:

	A. Knowledge and Understanding:
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a2	Describe the properties and behavior of radiopharmaceuticals used in diagnostic and therapeutic procedures
	B. Intellectual Skills:
b1	Analyze the interaction of radiation with matter and its implications in medical imaging.
b2	Evaluate the performance of nuclear medicine equipment and its impact on image quality and patient safety
	C. Professional and Practical kills:
c1	Explain the operation of key nuclear medicine instruments, including gamma cameras and PET scanners.
c2	Apply theoretical principles of radiation protection in nuclear medicine settings
	D. Transferable Skills:
d1	Demonstrate problem-solving skills in the context of nuclear medicine imaging
d2	Communicate effectively with interdisciplinary teams regarding nuclear medicine protocols and safety

IV. Course Contents:

A. Theoretical Aspect:

No.	Title	Sup-title	Number of Weeks	Contact Hours
1	**Introduction to Nuclear Medicine Physics**	– Overview of nuclear physics, history of nuclear medicine	1	2
2	**Radiation and Matter Interaction**	– Types of radiation, interactions with tissues, radiation absorption	1	2
3	**Radiation Detection Techniques**	– Scintillation detectors, ionization chambers, dosimetry	1	2
4	**Radiopharmaceuticals: Types and Applications**	– Diagnostic and therapeutic radiopharmaceuticals	1	2

No.	Title	Sup-title	Number of Weeks	Contact Hours
5	**Gamma Camera and PET Scanner Physics**	– Components, working principles, image formation in SPECT/PET	2	4
6	**Image Reconstruction and Processing**	– Mathematical modeling, Fourier transform, filter techniques	2	4
7	**Mid-term Exam**	– All Previous topics	1	2
8	**Nuclear Medicine Instrumentation**	– Performance characteristics, calibration, error analysis	2	4
9	**Quality Assurance in Nuclear Medicine**	– Routine checks, image quality standards, troubleshooting	2	4
10	**Radiation Protection and Safety**	– Safety protocols, shielding, radiation exposure limits	2	4
11	**Final Exam**	– All 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			
2			
3			
4			
5			
6			
7			
8			
9			
10			

No.	Tasks/ Experiments	Number of Weeks	Contact Hours
15			
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			

VII. Teaching Strategies:

- Lectures
- Case Studies
- Group Discussions
- Multimedia Resources

VII. Assessment Methods:

- Written Exams
- Quizzes
- Reports
- Participation

VII. Assignments:

No.	Assignments	Week Due	Mark
1			
2			
3			

No.	Assignments	Week Due	Mark
	Total		**10**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	**Mid-term Exam**	Week 8	15	15%
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