University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Course Specification of Nuclear Medicine Techniques

Course Code (BE478)

I. Course Identification and General Information:						
1	**Course Title:**	Nuclear Medicine Techniques				
2	**Course Code & Number:**	BE478				
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	--	--	2	3
4	**Study level/ semester at which this course is offered:**	5th Level / 2nd Semester				
5	**Pre –requisite (if any):**	Medical Imaging System 2 (BE469)				
6	**Co –requisite (if any):**	None				
7	**Program (s) in which the course is offered:**	Biomedical Engineering Program				
8	**Language of teaching the course:**	English				
9	**Location of Teaching the Course:**	Faculty of Engineering				
10	**Prepared by:**	Dr. Mohammed Al-olofi				
11	**Reviewed by:**	Dr. Waleed Al-Talbi				
12	**Date of Approval:**					

I. Course Description:

The nuclear medicine techniques course aims to give the student knowledge of basic physics concepts, theories of radiotherapy and nuclear medicine, principles of radioactivity and their applications in radiotherapy, and nuclear medicine and interaction of radiation with human body. The course includes the principles of gamma camera, SPECT, PET and linear acceleration. In addition to,

methods of obtaining useful images, image formation and display, radiation safety, and the types of detectors using in such machines.

III. Course Intended learning outcomes (CILOs) of the course (maximum 8CILOs)		**Referenced PILOs** (Only write code number of referenced Program Intended learning outcomes)
Knowledge and Understanding: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
a1	Illustrate the basic concepts, and principles, physical theories for the nuclear medicine equipment.	A1 Describe and explain the underlying mathematical methods and theories; life scientific-principles; and engineering core concepts related to the Biomedical Engineering context.
a2	Identify the techniques, operation, and design principles nuclear medicine equipment which are relevant to the developments and new technologies.	A2 Clarify the design principles and techniques and the engineering materials characteristics and how these are relevant to the developments and technologies in a biomedical systems context.
a3	Describe the clinical applications of nuclear medicine equipment, their operational theories and their clinical environments.	A3 Recognize and explain the need for a high level of management, professional and ethical behavior, responsibility, quality assurance systems, codes of practice, standards, health and safety requirements, and environmental impacts in biomedical systems.
B. Cognitive/ Intellectual Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
b1	Design the nuclear medicine equipment used in radiotherapy and nuclear medicine department with considerate environmental	B3 Design the biomedical systems or processes within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and

	conditions, health and safety, manufacturability and sustainability.	sustainability.
b2	Categorize the nuclear medicine equipment according to their specifications and features.	B5 Distinguish the main characteristics of biomedical systems, apply diagnostic skills and technical knowledge and perform failure analysis to these systems.
C. Professional and Practical Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
c1	Apply mathematical, simulation models, and IT software packages to nuclear medicine equipment effectively.	C2 Use a wide range of analytical tools, techniques, IT, modern engineering tools, software packages and develop required computer programs to solve, modeling and analyzing Biomedical Engineering problems.
c2	Install, operate, troubleshooting, and maintenance the nuclear medicine equipment by using rules and regulations of medical safety.	C4 Use rules and regulations of industrial safety as well as safe and diagnose systems at work, evaluate performance and observe the appropriate steps to manage risks concerning biomedical systems.
D. Transferable Skills: Upon successful completion of the undergraduate Biomedical Engineering Program, the graduates will be able to:		
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	D1 Lead and motivate individuals, show capability to work in stressful environments and within constraints, collaborate effectively within multidisciplinary team.

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies

a1 Illustrate the basic concepts, and principles, physical theories for the nuclear medicine equipment.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.
a2 Identify the techniques, operation, and design principles of nuclear medicine equipment which are relevant to the developments and new technologies.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.
a3 Describe the clinical applications of nuclear medicine equipment, their	• Interactive lectures & examples, • Tutorials,	• Written tests (mid and final terms and quizzes), • Short reports,

operational theories and their clinical environments.	• Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Coursework activities assessment, • Presentations.

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1 Design the nuclear medicine equipment used in radiotherapy and nuclear medicine department with considerate environmental conditions, health and safety, manufacturability and sustainability.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.
b2 Categorize the nuclear medicine equipment according	• Interactive lectures & examples,	• Written tests (mid and final terms and

to their specifications and features.	• Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	quizzes), • Short reports, • Coursework activities assessment, • Presentations.

(C) Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1 Apply mathematical, simulation models, and IT software packages to nuclear medicine equipment effectively.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.
c2 Install, operate, troubleshooting, and maintenance	• Interactive lectures & examples,	• Written tests (mid and final terms and

the nuclear medicine equipment by using rules and regulations of medical safety.	• Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	quizzes), • Short reports, • Coursework activities assessment, • Presentations.

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

Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1 Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.	• Interactive lectures & examples, • Tutorials, • Videos demonstrations, • Presentation/seminar, • Interactive class discussions, • Case studies, • Directed self- study, • Problem based learning, • Team work (cooperative learning), • Field visits/training,	• Written tests (mid and final terms and quizzes), • Short reports, • Coursework activities assessment, • Presentations.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1	**Introduction to Radiotherapy and Nuclear Medicine.**	a1, a2, a3	– Introduction to radiotherapy and nuclear medicine. – Elementary introduction to structure of matter, elements, compounds and mixtures molecules and atoms. – Atomic & nuclear structures, atomic models, periodic table, simple. – Ideas of quantum mechanics. – Mass energy equivalence. – Fluorescence. – Phosphorescence. – Luminescence. – Electromagnetic. – Spectrum. – Isobars, isotopes, isotones, isomers.	1	2
2	**Physics of Radioactivity**	a1, a2, a3	– Radioactivity, discovery. – Natural & artificial radioactivity. – Isotopes and nuclides. – Binding forces between nuclear particles. – Alpha & beta particles.	1	2

			– Gamma radiation. – Mechanisms of radioactive decay. – Alpha decay, beta-plus, beta-minus, gamma emission. – Units of activity (Becquerel, Curie), specific activity, kinetics of radioactive decay. – Statistics of radiation counting.		
3	**Interaction of Radiation with Human Body.**	a1, a2, a3, b1,b2, c1, c2	– Interaction of electrons with matter. – Radiation intensity & exposure. – Radiation dose. – Radiation quality. – Scattering. – Particle interactions. – Relative clinical importance.	1	2
4	**Radiation Detectors and Measurement**	a1, a2, a3, b1,b2, c1, c2	– Gas radiation detector. – Scintillation detectors (solid). – Scintillation detectors (Liquid). – Semiconductor detectors. – Gamma ray spectrometer. – Measurement of radioactivity.	1	2
5	**Radiation Safety in Nuclear Medicine**	a1, a2, a3, b1,b2, c1, c2	– Biological effects of radiation. – Radiation exposure (quantities and units). – Radiation regulations, dose limits. – Principles of radiation	1	2

			protection. – Guidelines for personnel, radiation monitoring. – Internal radiation dosimetry. – Radiation dose -quantities and units, ALARA program.		
6	**Gamma Camera (1)**	a1, a2, a3, b1,b2, c1, c2	– General concepts of radionuclide imaging, – Basic principles of the gamma camera. – System components. – Detector system and electronic. – Collimator. – Event detection in a gamma camera. – Types of gamma cameras and their clinical used.	1	2
7	**Gamma Camera (2)**	a1, a2, a3, b1,b2, c1, c2	– Measurements of gamma camera performance. – Resolution. – Sensitivity. – system resolution, Spatial volume resolution saturation. – maintenance and troubleshooting of gamma camera.	1	2
8	**Mid-Term Theoretical Exam**	a1, a2, a3, b1,b2, c1, c2	- All Previous Topics	1	2
9	**Single Photon Emission**	a1, a2, a3, b1,b2, c1, c2	– SPECT systems. – Gamma camera SPECT system.	1	2

	Computed Tomography (SPECT) - 1		– SPECT systems for brain imaging. – SPECT systems for cardiac imaging. – Practical implementation of SPECT		
10	**Single Photon Emission Computed Tomography (SPECT) - 2**	a1, a2, a3, b1,b2, c1, c2	– Performance characteristics of SPECT system. – Spatial resolution. – Volume sensitivity. – Other measurements of performance. – Quality assurance in SPECT. – Applications of SPECT – Maintenance and troubleshooting of SPECT.	1	2
11	**Positron Emission Tomography (PET) – 2**	a1, a2, a3, b1,b2, c1, c2	– Data acquisition for PET. – Tomographic image reconstruction, whole-body imaging. – Data corrections and quantitative a SPECT of PET. – Performance characteristics of PET systems. – Clinical and research applications of PET. – Maintenance and troubleshooting of PET.	1	2
12	**Report & Presentation**	a1, a2, a3, b1,b2, c1, c2, d1	– 3 to 4 students make a report and presentation about one of radiotherapy and nuclear	1	2

			medicine systems.		
13	**Positron Emission Tomography (PET) – 2**	a1, a2, a3, b1,b2, c1, c2	– Data acquisition for PET. – Tomographic image reconstruction, whole-body imaging. – Data corrections and quantitative a SPECT of PET. – Performance characteristics of PET systems. – Clinical and research applications of PET. – Maintenance and troubleshooting of PET.	1	2
14	**Linear acceleration (1)**	a1, a2, a3, b1,b2, c1, c2	– Basic principles of linear acceleration, – System design and Components	1	2
15	**Linear acceleration (2)**	a1, a2, a3, b1,b2, c1, c2	– Performance characteristics of linear acceleration systems, – Clinical and research applications of linear acceleration systems, – maintenance and troubleshooting of linear acceleration systems.	1	2
16	**Final Theoretical Exam**	a1, a2, a3, b1,b2, c1, c2	- All Topics	1	2
Number of Weeks /and Units Per Semester				**16**	**32**

V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Directed self- study,
- Problem based learning,
- Team work (cooperative learning),
- Field visits/training,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,
- Coursework activities assessment,
- Presentations.

VII. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Problems of the Physics of Radioactivity	a1, a2	2	3
2	Problems of the Interaction of	a1, a2	3	3

	Radiation with Human Body			
3	Problems of the Radiation Detectors and Measurement	a1, a2, b1, b2, b3	5	3
4	Problems of the Radiation Safety in Nuclear Medicine	a1, a2, b1, b2, b3	9	3
5	Problems of the Gamma Camera	a1, a2, b1, b2, b3, c1, c2	10	6
6	Problems of the SPECT and PET	a1, a2, b1, b2, b3, c1, c2	13	6
7	Problems of the Linear acceleration	a1, a2, b1, b2, b3, c1, c2	15	6
Total				30

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	**Assignments**	15	30	20%	a1, a2, b1, b2, b3, c1, c2
2	**Quiz 1**	6	10	3.33%	a1, a2, b1, b2, b3
3	**Midterm Theoretical Exam**	8	20	13.33%	a1, a2, b1, b2, b3
4	**Quiz 2**	11	5	3.33%	a1, a2, b1, b2, b3, c1, c2
5	**Report & Presentation**	12	15	10%	a1, a2, b1, b2, b3, c1, c2, d1
6	**Final Theoretical Exam**	16	70	46.67%	a1, a2, b1, b2, b3, c1, c2

Total	150	100%	

IX. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

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

1- Simon R. Cherry, James A. Sorenson, Michael E. Phelps, 2012, **Physics of Nuclear Medicine**, 4th edition, ElSEVIER.

2- Ramesh Chandra, 2017, **Nuclear Medicine Physics: The Basics**, 8th edition, Walters Kluwer, Lippincott Williams & Wilkins ISBN : 1451109415.

2- Essential References.

3- Bruce Sodee, Paul J.Early, **Principles and practice of Nuclear Medicine**, Wikepry

4- Donald R. Bernier , Paul E. Christian & James, **Nuclear Medicine Technology & Techniques**,

3- Electronic Materials and Web Sites *etc*.

Websites:

5- The IEEE Transactions on Nuclear Science. Peer reviewed academic journal in the field of Nuclear Science.

http://www.ieeexplore.ieee.org/xpl/recentissue.jsp

Journals:

6- Journal of nuclear medicine: Peer reviewed academic journal in the field of nuclear medicine.

http://jnm.nmjournals.org/

7- European journal of nuclear medicine and molecular imaging

https://www.springer.com/journal/259

Other Web Sources:

8- Website: Society of nuclear medicine and molecular imaging

http://www.snmmi.com

X. Course Policies:	
1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating**: For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism**: Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.
7	**Other policies**:

	- Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.

University of Sana'a
Faculty of Engineering
Department: Biomedical Engineering
Title of the Program: Biomedical Engineering

Template for Course Plan (Syllabus)

Nuclear Medicine Techniques - BE478

I. Course Identification and General Information:					
1	**Course Title:**	Nuclear Medicine Techniques			
2	**Course Code & Number:**	BE478			
3	**Credit Hours:**	**Credit Hours**	**Theory Hours**		**Lab. Hours**
			Lecture	**Exercise**	
		3	2	2	--
4	**Study Level/ Semester at which this Course is offered:**	5^{th} Level / 2^{nd} Semester			
5	**Pre –Requisite (if any):**	Medical Imaging System 2 (BE469)			
6	**Co –Requisite (if any):**	None			
7	**Program (s) in which the Course is Offered:**	Bachelor of Biomedical Engineering			
8	**Language of Teaching the Course:**	English			
9	**Location of Teaching the Course:**	Faculty of Engineering			
10	**Prepared by:**	Dr. Mohammed Al-olofi			
11	**Reviewed by:**	Dr. Waleed Al-Talbi			
12	**Date of Approval:**				

II. Course Description:

The nuclear medicine techniques course aims to give the student knowledge of basic physics concepts, theories of radiotherapy and nuclear medicine, principles of radioactivity and their applications in radiotherapy, and nuclear medicine and interaction of radiation with human body. The course includes the principles of gamma camera, SPECT, PET and linear acceleration. In addition to,

methods of obtaining useful images, image formation and display, radiation safety, and the types of detectors using in such machines.

III. Course Intended Learning Outcomes (CILOs): (مخرجات تعلم المقرر)	
A. Knowledge and Understanding: Upon successful completion of the course, students will be able to:	
a1	Illustrate the basic concepts, and principles, physical theories for the nuclear medicine equipment.
a2	Identify the techniques, operation, and design principles nuclear medicine equipment which are relevant to the developments and new technologies.
a3	Describe the clinical applications of nuclear medicine equipment, their operational theories and their clinical environments.
B. Intellectual Skills: Upon successful completion of the course, students will be able to:	
b1	Design the nuclear medicine equipment used in radiotherapy and nuclear medicine department with considerate environmental conditions, health and safety, manufacturability and sustainability.
b2	Categorize the nuclear medicine equipment according to their specifications and features.
C. Professional and Practical Skills: Upon successful completion of the course, students will be able to:	
c1	Apply mathematical, simulation models, and IT software packages to nuclear medicine equipment effectively.
c2	Install, operate, troubleshooting, and maintenance the nuclear medicine equipment by using rules and regulations of medical safety.
D. Transferable Skills: Upon successful completion of the course, students will be able to:	
d1	Function effectively in different work environments as an individual, and as a member or leader in multi-disciplinary teams.

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
1	**Introduction to Radiotherapy and Nuclear Medicine.**	– Introduction to radiotherapy and nuclear medicine. – Elementary introduction to structure of matter, elements, compounds and mixtures molecules and atoms. – Atomic & nuclear structures, atomic models, periodic table, simple. – Ideas of quantum mechanics. – Mass energy equivalence. – Fluorescence. – Phosphorescence. – Luminescence. – Electromagnetic. – Spectrum. – Isobars, isotopes, isotones, isomers.	1	2
2	**Physics of Radioactivity**	– Radioactivity, discovery. – Natural & artificial radioactivity. – Isotopes and nuclides. – Binding forces between nuclear particles. – Alpha & beta particles. – Gamma radiation. – Mechanisms of radioactive decay.	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Alpha decay, beta-plus, beta-minus, gamma emission. – Units of activity (Becquerel, Curie), specific activity, kinetics of radioactive decay. – Statistics of radiation counting.		
3	**Interaction of Radiation with Human Body.**	– Interaction of electrons with matter. – Radiation intensity & exposure. – Radiation dose. – Radiation quality. – Scattering. – Particle interactions. – Relative clinical importance.	1	2
4	**Radiation Detectors and Measurement**	– Gas radiation detector. – Scintillation detectors (solid). – Scintillation detectors (Liquid). – Semiconductor detectors. – Gamma ray spectrometer. – Measurement of radioactivity.	1	2
5	**Radiation Safety in Nuclear Medicine**	– Biological effects of radiation. – Radiation exposure (quantities and units). – Radiation regulations, dose limits. – Principles of radiation protection.	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– Guidelines for personnel, radiation monitoring. – Internal radiation dosimetry. – Radiation dose -quantities and units, ALARA program.		
6	**Gamma Camera (1)**	– General concepts of radionuclide imaging, – Basic principles of the gamma camera. – System components. – Detector system and electronic. – Collimator. – Event detection in a gamma camera. – Types of gamma cameras and their clinical used.	1	2
7	**Gamma Camera (2)**	– Measurements of gamma camera performance. – Resolution. – Sensitivity. – system resolution, Spatial volume resolution saturation. – maintenance and troubleshooting of gamma camera.	1	2
8	**Mid-Term Theoretical Exam**	- All Previous Topics	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
9	**Single Photon Emission Computed Tomography (SPECT) - 1**	– SPECT systems. – Gamma camera SPECT system. – SPECT systems for brain imaging. – SPECT systems for cardiac imaging. – Practical implementation of SPECT	1	2
10	**Single Photon Emission Computed Tomography (SPECT) - 2**	– Performance characteristics of SPECT system. – Spatial resolution. – Volume sensitivity. – Other measurements of performance. – Quality assurance in SPECT. – Applications of SPECT – Maintenance and troubleshooting of SPECT.	1	2
11	**Positron Emission Tomography (PET) – 2**	– Data acquisition for PET. – Tomographic image reconstruction, whole-body imaging. – Data corrections and quantitative a SPECT of PET. – Performance characteristics of PET systems. – Clinical and research applications	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		of PET. – Maintenance and troubleshooting of PET.		
12	**Report & Presentation**	– 3 to 4 students make a report and presentation about one of radiotherapy and nuclear medicine systems.	1	2
13	**Positron Emission Tomography (PET) – 2**	– Data acquisition for PET. – Tomographic image reconstruction, whole-body imaging. – Data corrections and quantitative a SPECT of PET. – Performance characteristics of PET systems. – Clinical and research applications of PET. – Maintenance and troubleshooting of PET.	1	2
14	**Linear acceleration (1)**	– Basic principles of linear acceleration, – System design and Components	1	2
15	**Linear acceleration (2)**	– Performance characteristics of linear acceleration systems, – Clinical and research applications of linear acceleration systems,	1	2

IV. Course Contents:

A. Theoretical Aspect:

No.	Units/Topics List	Sub Topics List	Number of Weeks	Contact Hours
		– maintenance and troubleshooting of linear acceleration systems.		
16	**Final Theoretical Exam**	- All Topics	1	2
Number of Weeks /and Units Per Semester			**16**	**32**

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V. Teaching Strategies of the Course:

- Interactive lectures & examples,
- Tutorials,
- Videos demonstrations,
- Presentation/seminar,
- Interactive class discussions,
- Case studies,
- Directed self- study,
- Problem based learning,
- Team work (cooperative learning),
- Field visits/training,

VI. Assessment Methods of the Course:

- Written tests (mid and final terms and quizzes),
- Short reports,

VI. Assessment Methods of the Course:

- Coursework activities assessment,
- Presentations.

VII. Assignments:

No.	Assignments	Week Due	Mark
1	Problems of the Physics of Radioactivity	2	3
2	Problems of the Interaction of Radiation with Human Body	3	3
3	Problems of the Radiation Detectors and Measurement	5	3
4	Problems of the Radiation Safety in Nuclear Medicine	9	3
5	Problems of the Gamma Camera	10	6
6	Problems of the SPECT and PET	13	6
7	Problems of the Linear acceleration	15	6
Total			**30**

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
1	**Quiz 1**	6	5	3.33%
1	**Assignments**	15	30	20%

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

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment
2	**Quiz 1**	6	10	3.33%
3	**Midterm Theoretical Exam**	8	20	13.33%
4	**Quiz 2**	11	5	3.33%
5	**Report & Presentation**	12	15	10%
6	**Final Theoretical Exam**	16	70	46.67%
Total			**150**	**100%**

IX. Learning Resources:

- *Written in the following order:*

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

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

1- Simon R. Cherry, James A. Sorenson, Michael E. Phelps, 2012, **Physics of Nuclear Medicine**, 4th edition, ElSEVIER.

2- Ramesh Chandra, 2017, **Nuclear Medicine Physics: The Basics**, 8th edition, Walters Kluwer, Lippincott Williams & Wilkins ISBN : 1451109415.

2- Essential References:

1- Bruce Sodee, Paul J.Early, **Principles and practice of Nuclear Medicine**, Wikepry

2- Donald R. Bernier , Paul E. Christian & James, **Nuclear Medicine Technology & Techniques**,

3- Electronic Materials and Web Sites etc.:

Websites:

1- The IEEE Transactions on Nuclear Science. Peer reviewed academic journal in the field of Nuclear Science.

http://www.ieeexplore.ieee.org/xpl/recentissue.jsp

IX. Learning Resources:

Journals:

2- Journal of nuclear medicine: Peer reviewed academic journal in the field of nuclear medicine. http://jnm.nmjournals.org/

3- European journal of nuclear medicine and molecular imaging https://www.springer.com/journal/259

Other Web Sources:

4- Website: Society of nuclear medicine and molecular imaging http://www.snmmi.com

X. Course Policies:

1	**Class Attendance:** A student should attend not less than 75 % of total hours of the subject; otherwise he/she will not be able to take the exam and will be considered as exam failure. If the student is absent due to illness, he/she should bring a proof statement from university Clinic. If the absent is more than 25% of a course total contact hours, student will be required to retake the entire course again.
2	**Tardy:** For late in attending the class, the student will be initially notified. If he repeated lateness in attending class, he/she will be considered as absent.
3	**Exam Attendance/Punctuality:** A student should attend the exam on time. He/she is permitted to attend an exam half one hour from exam beginning, after that he/she will not be permitted to take the exam and he/she will be considered as absent in exam
4	**Assignments & Projects**: In general one assignment is given to the students after each chapter; the student has to submit

	all the assignments for checking on time, mostly one week after given the assignment.
5	**Cheating:** For cheating in exam, a student will be considered as fail. In case the cheating is repeated three times during his/her study the student will be disengaged from the Faculty.
6	**Plagiarism:** Plagiarism is the attending of a student the exam of a course instead of another student. If the examination committee proofed a plagiarism of a student, he/she will be disengaged from the Faculty. The final disengagement of the student from the Faculty should be confirmed from the Student Council Affair of the university or according to the university roles.
7	**Other policies:** - Mobile phones are not allowed to use during a class lecture. It must be closed; **otherwise** the student will be asked to leave the lecture room. - Mobile phones are not allowed in class during the examination. - Lecture notes and assignments might be given directly to students using soft or hard copy.