

Module Title	Physics of Nuclear Medicine		Module Delivery	
Module Type	Core		<input checked="" type="checkbox"/> Theory <input checked="" type="checkbox"/> Lecture <input checked="" type="checkbox"/> Lab <input type="checkbox"/> Tutorial <input type="checkbox"/> Practical <input type="checkbox"/> Seminar	
Module Code	UOMU0301062			
ECTS Credits	6			
SWL (hr/sem)	150			
Module Level	3	Semester of Delivery		
Administering Department	Type Dept. Code	College	Type College Code	
Module Leader	Prof.Dr. Fouad Attia Majeed		e-mail	fouad.attia.majeed@uomus.edu.iq
Module Leader's Acad. Title	Professor		Module Leader's Qualification	Ph.D.
Module Tutor	Name (if available)		e-mail	E-mail
Peer Reviewer Name	Name		e-mail	E-mail
Scientific Committee Approval Date	01/06/2023		Version Number	1.0

Relation with other Modules			
العلاقة مع المواد الدراسية الأخرى			
Prerequisite module	None		Semester
Co-requisites module	None		Semester

Module Aims, Learning Outcomes and Indicative Contents	
أهداف المادة الدراسية ونتائج التعلم والمحتويات الإرشادية	
Module Objectives أهداف المادة الدراسية	This course offers the introduction of various types of nuclear medicine counting equipment such as gas-filled detector, scintillation detector and semiconductor detector as well as using appropriated nuclear counting statistic method. Students will develop a beginning

	<p>understanding of nuclear medicine equipment, imaging quality and image noise analysis in nuclear medicine. Explored in this course are the basic principles of non-imaging equipment in nuclear medicine, gamma camera, SPECT, PET, hybrid imaging (e.g. SPECT/CT and PET/CT) and BMD.</p> <p>This course examines radionuclide production, mechanisms of radionuclide localization the use and preparation of radiopharmaceuticals for both diagnostic and therapeutic applications and quality control of radiopharmaceuticals. This course also emphasizes on the dose calculation from internalized radionuclide with standard dosimetry method such as MIRD (Medical Internal Radiation Dose).</p>
<p>Module Learning Outcomes</p> <p>مخرجات التعلم للمادة الدراسية</p>	<p>1 Student can understand various types of radiation detection equipment for unsealed source with appropriate statistical methods</p> <p>2-Student can understand the basic principle of imaging equipment in nuclear medicine and also demonstrate, manage basic constancy tests, QC program and analyze the results with appropriate reaction</p> <p>3- Student can explain the basic principle of radionuclide production, mechanisms of radionuclide localization the use and preparation of radiopharmaceuticals for both diagnostic and therapeutic applications and basic quality control of radiopharmaceuticals</p> <p>4-Student can compute dose from internalized radionuclide with standard dosimetry method</p> <p>5- Student can discuss the current and future roles of nuclear medicine in medical imaging</p> <p>6.Student can communicate and share the knowledge on medical physics in nuclear medicine by effective presentation skills</p> <p>7.Student can value the professional conduct, professional development in team working and leadership skills</p>
<p>Indicative Contents</p> <p>المحتويات الإرشادية</p>	

Learning and Teaching Strategies

استراتيجيات التعلم والتعليم

Strategies	The use of nuclear medicine radiotracers in medicine requires close coordination between various professionals, including:
	The medical physicist - who is often involved in calculating hypothetical radiation doses to a patient and the public
	The nuclear pharmacist - who plays a role in radiotracer preparation
	The NM technician - who plays an important role in screening, preparing, and imaging the patient
	The nuclear medicine physician - who supervises all aspects of nuclear medicine care as well as directing therapy and performing image interpretation
	Inpatient nurses and the inpatient team - who sometimes play a role in inpatient admissions, such as in the case of admission during treatments and/or complications thereof
	The referring provider - who often plays a central role in the patient selection and their initial education regarding the role of nuclear medicine in diagnosis and treatment
The involvement of multiple professionals is critical, considering the radiation dose often incurred on the public during the administration of certain radiopharmaceuticals. Close communication between members of the treatment team is critical in relating the amount of radioactivity to be expected, the way to shield workers and the public from radiation exposure, and the way to optimize patient treatment either in the setting of the diagnostic evaluation of disease or in the setting of therapy.	

Student Workload (SWL)			
الحمل الدراسي للطالب محسوب لـ ١٥ اسبوعا			
Structured SWL (h/sem) الحمل الدراسي المنتظم للطالب خلال الفصل	60	Structured SWL (h/w) الحمل الدراسي المنتظم للطالب أسبوعيا	4
Unstructured SWL (h/sem) الحمل الدراسي غير المنتظم للطالب خلال الفصل	90	Unstructured SWL (h/w) الحمل الدراسي غير المنتظم للطالب أسبوعيا	31
Total SWL (h/sem) الحمل الدراسي الكلي للطالب خلال الفصل	150		

Module Evaluation					
تقييم المادة الدراسية					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10% (10)	5 and 10	LO #1, #2 and #10, #11
	Assignments	2	10% (10)	2 and 12	LO #3, #4 and #6, #7
	Report	1	10% (10)	13	LO #5, #8 and #10
Summative assessment	Midterm Exam	2hr	20% (20)	7	LO #1 - #7
	Final Exam	3hr	50% (50)	16	All
Total assessment			100% (100 Marks)		

Delivery Plan (Weekly Syllabus)	
المنهاج الاسبوعي النظري	
	Material Covered
Week 1	Basic Nuclear Physics: Composition and structure of the Atomic Nucleus. Energy Levels and Binding Energies. Nuclear stability and instability
Week 2	Radioactivity and modes of radioactive decay: Physics of radiation and radioactivity, natural and artificial radiation. Alpha, beta, gamma-decay, electron capture and decay, isomeric transitions and internal conversion. calculations of radioactive decay, exponential equations, calculations of radiation dosimetry, half-life equations,
Week 3	Radionuclide production: Activation and activation cross sections. Nuclear Fission and Nuclear Reactors, Radioactive Equilibrium and Radionuclide Generators. Charged-particle accelerators: cyclotron and other types of accelerators, radiopharmaceutical dose determinations.

Week 4	Basic structure of photon counting detectors: Collimators, Scintillators and optical photon detectors (photomultiplier tubes, Silicon Photomultipliers-SiPM, Avalanche photodiodes-APD). Direct detection techniques by semiconductors and photoconductors technology.
Week 5	Gamma-ray spectroscopy: Shapes and structure of gamma-ray spectra, energy resolution, pulse height spectrometry, use of energy window.
Week 6	Imaging Instrumentation of Nuclear Medicine: Basic aspects in imaging and non-imaging radiation detection instrumentation including: scintillation detectors, multichannel analyzers, planar gamma camera, SPECT (single photon emission computerized tomography), PET (positron emission tomography), Hybrid PET/CT and PET/MRI scanners, quality assurance testing for Nuclear Medicine instrumentation including G-M detectors, ionization chambers and scintillation detectors. Image fusion for SPECT/CT, PET/CT and PET/MRI.
Week 7	Mid-term Exam
Week 8	Image Quality and Quality Control in Nuclear Medicine: Basic image quality parameters in nuclear medicine. Contrast detail and Observer Performance characteristics. Quality control and acceptance testing protocols
Week 9	Internal Dosimetry and Therapeutic applications: Diagnostic and therapeutic radiopharmaceutical and organ doses, Methods for dose calculation in organs and tissues, new software for organ calculation eg. OLINDA/EXM, absorbed fractions, modeling assumptions or Monte Carlo calculations, anthropomorphic 'phantoms' mathematical models of the human body, the role of SPECT and PET in internal dosimetry calculations. Monte Carlo simulations for radiation dose estimation.
Week 10	Clinical Nuclear Medicine radiopharmacy: Production of radionuclides, radiopharmaceutical chemistry, radiopharmaceuticals and methods of radiolabeling, characteristics of specific radiopharmaceuticals,
Week 11	Molecular Imaging: theory and applications of molecular imaging and how this impact clinical studies, patient monitoring, drug industry, etc.

Week 12	biodistributions and physiological mechanisms of tracer uptake, pharmacokinetics, specific activity, concentration determination,
Week 13	dose calculations, methods of dispensing, quality assurance of radiopharmaceuticals, and universal precautions.
Week 14	revision
Week 15	Preparatory week before the final Exam
Week 16	

Delivery Plan (Weekly Lab. Syllabus)

المنهاج الاسبوعي للمختبر

	Material Covered
Week 1	Lab 1: The Gamma Camera
Week 2	Lab 2: Radionuclide image quality
Week 3	Lab 3: Radionuclide tomographic imaging: Positron Emission Tomography (PET), PET-CT, Single Photon Emission Computed Tomography (SPECT)
Week 4	Lab 4: Patient exposure and protection
Week 5	Lab 5: Radiation measurement
Week 6	Lab 6: Principles of radiochemistry, radio-immunoimaging, and the radiopharmacy
Week 7	Lab 7: Quality Control issues in nuclear medicine.

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?

Required Texts	D.L. Bailey, J.L. Humm, A. Todd-Pokropek, A. van Aswegen Nuclear Medicine Physics. A Handbook for Teachers and Students. IAEA 2014	no
	S. Cherry, J. Sorensen, M. Phelps. Physics in nuclear medicine. Sixth ed. Philadelphia, Saunders/Elsevier, 2012.	
Recommended Texts		
Websites		

Grading Scheme مخطط الدرجات				
Group	Grade	التقدير	Marks %	Definition
Success Group (50 - 100)	A - Excellent	امتياز	90 - 100	Outstanding Performance
	B - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group (0 - 49)	FX – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
	F – Fail	راسب	(0-44)	Considerable amount of work required
<p>Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.</p>				

MODULE DESCRIPTION FORM