MODULE DESCRIPTION FORM

Module Information				
Module Title	Quantum mechanics in medicine		Module Delivery	
Module Type	Core		☒Lecture	
Module Code	MP303			
ECTS Credits	4			
SWL (hr/sem)	100			
Module Level	UG III	Semester of Delivery	1	
Administering Department	Medical Physics	College	College of Science	
Module Leader	Dr. Ismail Mohamed Eldesoky	e-mail	Ismail.M@uowa.edu.iq	
Module Leader's Acad. Title	Asist. Lecturer	Module Leader's Qualification	PhD.	
Module Tutor	Dr. Ismail Mohamed Eldesoky	e-mail	Ismail.M@uowa.edu.iq	
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Scientific Committee Approval Date	1 – 9 - 2025	Version Number	1	

Relation with other Modules			
Prerequisite module	-	Semester	-
Co-requisites module	-	Semester	-

جامعة وارث الانبياء
كلية العلوم
قسم الفيزياء الطبية

Department Head Approval

Dean of the College Approval

Module Aims, Learning Outcomes and Indicative Contents	
Module Aims	1. Provide students with a solid foundation in the principles of quantum mechanics relevant to medical applications. 2. Explain wave–particle duality, uncertainty principle, quantum states, and tunneling with emphasis on biomedical contexts. 3. Demonstrate how quantum mechanics underpins the operation of advanced medical technologies 4. Highlight the importance of quantum phenomena in understanding biological processes at molecular and cellular levels. 5. Train students to apply quantum mechanical models to solve problems in medical imaging, radiation therapy, and Nano-medicine. 6. Foster the ability to use mathematical formulations (e.g., Schrödinger equation) to analyze biomedical systems. 7. Encourage critical thinking about ongoing research in quantum biology and quantum medicine. 8. Motivate students to explore interdisciplinary applications linking physics, biology, and medical engineering. 9. Develop awareness of safety, ethical, and practical considerations in applying quantum technologies in medicine. . Analyze challenges, limitations, and future perspectives of quantum-based medical practices.

Module Learning Outcomes	1. Explain fundamental concepts of quantum mechanics (wave–particle duality, quantization, uncertainty principle, spin) and relate them to biomedical systems. 2. Describe the quantum mechanical principles underlying medical imaging and therapeutic technologies. 3. Discuss the role of quantum phenomena in biological processes such as photosynthesis, enzyme reactions, and neural signaling. 4. Solve quantitative problems related to quantum mechanics in medical physics (e.g., energy levels, spin states, resonance conditions). 5. Use quantum-based models to interpret experimental and imaging data in medical applications. 6. Communicate complex quantum medical concepts effectively through written reports and presentations. 7. Integrate interdisciplinary knowledge from physics, medicine, and engineering to propose innovative healthcare solutions. Recognize ethical, safety, and societal considerations in applying quantum technologies in medicine.
Indicative Contents	<u>Theory Lectures</u> Learning concepts of each theoretical lecture or groups of lectures. [SSWL= hrs] <u>Lab. Lectures</u> Learning concepts of each laboratory lecture or groups of lectures. [SSWL= hrs] Mid Exam = 1hr Final Exam = 3hrs Total hrs = 100hrs

Learning and Teaching Strategies	
Strategies	1. Lecture 2. Flipped classroom 3. Problem-based learning (PBL) 4. Peer teaching and collaborative learning 5. Reflective practice

Student Workload (SWL)			
Structured SWL (h/sem)	48	Structured SWL (h/w)	3.2
Unstructured SWL (h/sem)	52	Unstructured SWL (h/w)	3.4
Total SWL (h/sem)	100 hrs		

Module Evaluation					
		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	2	10	5,11	1,2,3,4
	Outsite assignment	2	10	14	All
	Insite Assignments	-	-	-	-
	Projects	1	10	6,12	All
	Report	1	10	4,8	All
Summative assessment	Midterm Exam	1	10	6	
	Final Exam	3	50	16	
Total assessment			100 Marks		

Delivery Plan (Weekly Syllabus)	
	Material Covered
Week 1	Introduction • Overview of the course and objectives • Historical background: from classical physics to quantum mechanics Importance of quantum mechanics in modern medicine
Week 2	Wave-Particle Duality
Week 3	The uncertainty principle
Week 4	Wave function
Week 5	Operators and Observables
Week 6	Expectation Value and Variance
Week 7	Mid. Exam
Week 8	Schrödinger equation (concept and applications)
Week 9	Atomic & Molecular Structure in Medicine • Quantum description of atoms and molecules • Electron spin, Pauli exclusion • principle Basis for spectroscopy and imaging in medicine
Week 10	Quantum Medicine Practices • Biophotons • Detection and measurement of Biophotons
Week 11	Sources of biophoton emission in biological systems
Week 12	Quantum Mechanics of Radiation • Interaction of radiation with matter • Quantization of electromagnetic fields • Principles of lasers and their medical applications (surgery, therapy, diagnostics)
Week 13	The Future of Quantum Medicine
Week 14	Applications of Quantum Medicine
Week 15	Student Presentations & Course Review

Learning and Teaching Resources

	Text	Available in the Library?
Required Texts	INTRODUCTION TO QUANTUM MECHANICS, 2rd, 2018, Cambridge University Press .	NO
Recommended Texts	Modern Physics in Medicine: From Quantum Mechanics to Medical Imaging, 1st,2025, Bright Sky Publications.	NO
Websites	https://www.heraldopenaccess.us/article_pdf/9/towards-quantum-medicine.pdf	

Grading Scheme

Group	Grade	Mark	Marks (%)	Definition
Success Group (50 - 100)	A - Excellent	Excellent	90 - 100	Outstanding Performance
	B - Very Good	Very Good	80 - 89	Above average with some errors
	C - Good	Good	70 - 79	Sound work with notable errors
	D - Satisfactory	Fair / Average	60 - 69	Fair but with major shortcomings
	E - Sufficient	Pass / Acceptable	50 - 59	Work meets minimum criteria
Fail Group (0 – 49)	FX – Fail	Fail (Pending)	(45-49)	More work required but credit awarded
	F – Fail	Fail	(0-44)	Considerable amount of work required

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.