Study Plans

Faculty : Sciences **Dept :** Physics

Major : 40301 Medical Physics **Edition :** 47 **Total HRS :** 140

Level First

course code	course name	Prerec	Prerec Name
PHYS1101	General Physics 1		
MTH1101	Calculus 1		
ELIN1301	English Language (1)		
BIO1101	General Biology		
QR1101	Tajweed of The Holy Quran		
IND1101	Design Thinking		
MTH1111	Linear Algebra		

Level Second

course code	course name	Prerec	Prerec Name
PHYM2101	Medical Physics	PHYS1101	١ General Physics
PHYS1102	General Physics 2	PHYS1101	١ General Physics
MTH1102	Calculus 2	MTH1101	١ Calculus
BIO1301	Anatomy and physiology	BIO1101	General Biology
QR2102	Memorizing the Holy Quran 1		
CUR1101	University Skills		
ELIN1302	English Language (2)	ELIN1301	(١) English Language

Level Third

course code	course name	Prerec	Prerec Name
PHYS3906	Introductory Nuclear Physics	PHYM2101	Medical Physics
PHYS3903	Introductory Modern Physics	PHYS1102	٢ General Physics
PHYS3904	Theoretical Methods in Medical Physics	MTH1102	٢ Calculus
PHYS3905	Optics and Waves	PHYS1102	٢ General Physics
QR2103	Memorizing the Holy Quran 2		
PHYS3902	Fundamentals of Electricity and magnetism	PHYS1102	٢ General Physics
AI2001	Introduction to Artificial Intelligence		

Level Fourth

course code	course name	Prerec	Prerec Name
PHYM4201	Medical Radiation Physics (1)	PHYS3906	Introductory Nuclear Physics
PHYS4907	Material Science	PHYS3903	Introductory Modern Physics
PHYS4908	Fundamentals of Quantum Mechanics	PHYS3903	Introductory Modern Physics
PHYS4909	Introductory Classical Mechanics	PHYS3904	Theoretical Methods in Medical Physics
ICC1201	Values and Ethics		
CHM1101	General Chemistry 1		
QR3104	Seal of the Holy Quran	QR1101	Tajweed of The Holy Quran

Level Fifth

course code	course name	Prerec	Prerec Name
PHYM5303	Physics of Medical Imaging (1)	PHYM4201	(١) Medical Radiation Physics
PHYM5301	Nuclear medicine physics	PHYM4201	(١) Medical Radiation Physics
PHYM5302	Physics of Radiation Therapy (1)	PHYM4201	(١) Medical Radiation Physics
PHYS5910	Fundamentals of Electronics	PHYS4907	Material Science

Level Sixth

course code	course name	Prerec	Prerec Name
PHYM6202	Medical Radiation Physics (2)	PHYM4201	(١) Medical Radiation Physics
PHYM6306	Physics of Medical Imaging (2)	PHYM5303	(١) Physics of Medical Imaging
PHYM8203	Radiation protection and dosimetry	PHYM5301	Nuclear medicine physics
PHYM6304	Physics of Radiation Therapy (2)	PHYM5302	(١) Physics of Radiation Therapy
PHYM6305	Quality Controls in medical physics	PHYM5303	(١) Physics of Medical Imaging
ICC4202	Family in Islam		

Level Seventh

course code	course name	Prerec	Prerec Name
PHYM7700	Co-op training		

Level Eighth

course code	course name	Prerec	Prerec Name
BUS1099	Professional skills		
PHYM8912	Graduation project		
PHYM8404	Biomaterials	PHYS4907	Material Science
PHYM8403	Computer Applications in Medical Physics	PHYM6304	(٢) Physics of Radiation Therapy
PHYM8401	Medical Physics Instrumentation	PHYS5910	Fundamentals of Electronics
PHYM8402	Health Physics	PHYM4201	(١) Medical Radiation Physics

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Study Plans

Faculty : Sciences **Dept :** Physics

Major : 40301 Medical Physics **Edition :** 47 **Total HRS :** 140

Level			
course code	course name	Prerec	Prerec Name
PHYM8805	Biosensors	PHYM8203	Radiation protection and dosimetry
PHYM8804	Medical biophysics	PHYM6202	(٢) Medical Radiation Physics
PHYM8803	Isotopes in Medicine	PHYM5301	Nuclear medicine physics
PHYM8802	Nonionizing radiation in medicine	PHYM5303	(١) Physics of Medical Imaging
PHYM8801	Nanomaterials in Medicine	PHYM5302	(١) Physics of Radiation Therapy
CS2001	Digital Technology		
ECO4312	E-commerce		
ARS1601	Writing and Public Speaking		
HIS4315	Heritage and Cultural Diversity		
SPED1102	Justice and equality		
PSY3127	Life Skills		
FIN3703	Financial planning skills		
THM3191	Tourism and Hospitality		
HP3009	Community Health		
PHYM8806	Medical image processing	PHYM6306	(٢) Physics of Medical Imaging
BUS1098	Innovation and Entrepreneurship		

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Education & Training Evaluation Commission
اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	General Biology
Course Code:	BIO 1101
Program:	BSc Biology
Department:	Biology
College:	Sciences
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	22/12/2-024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:

3 credits

2. Course type

A.	☐University	☒ College	☐ Department	☐Track	☐Others
B.	☒ Required			☐Elective	

3. Level/year at which this course is offered:

1st year / 1st level

4. Course general Description:

General Biology provides an overview of life on Earth, the evolutionary relationships among major groups of organisms, and the structural and functional characteristics of these organisms. The course covers major areas of biology ranging from cellular to whole organism and includes the study of ecosystems. The focus on cellular level processes leads to an understanding of the importance and roles of the cell. By comparing the processes in unicellular organism and multicellular plants and animals, candidates investigate the increasing levels of life complexity. The key areas of biodiversity and interdependence are covered, along with the processes leading to evolution as well as food security and ethical issues. General Biology is intended primarily for students majoring in any of the biological sciences or life science-related fields (Chemistry, physics, and mathematics). Practical lessons include general rules for safety in Biology Lab. Study of different cell organelles, stages of cell division, plant growth experiments and hormones, and osmosis and diffusion

5. Pre-requirements for this course (if any)**:**

N/A

6. Pre-requirements for this course (if any)**:**

N/A

7. Course Main Objective(s):

The main objective of this course is to give an overview of the many features that are common to living organisms and what is meant by "life" and "living organisms.

2. Teaching mode (mark all that apply)

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No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30 h
2.	**Laboratory/Studio**	45 h
3.	**Field**	---
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understanding the basic biological principles through an integrated approach	K1	lectures	exams
1.2	Recognize the cellular processes of living organisms with an emphasis on biological chemistry applications.	K1 & K2	lectures	exams
1.3	Identify the unifying themes and key concepts of different organisms	K2	lectures	Exams
1.4	Describe the anatomy, function, genetics, and	K2	lectures	Exams

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Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	evolution of different types of organisms			
1.5	Demonstrate factual knowledge of contemporary natural science.	K2	lectures	exams
…				
2.0	**Skills**			
2.1	The student will apply contemporary scientific models to describe the natural world	S1		
2.2	Conduct the scientific method	S1 & 2		
2.3	Solve problems, including observation, inference, measurement, prediction, use of numbers, classifying and use of space and time	S1 & S3		
2.4	Demonstrate integrated process skills, including identification and control of variables, interpretation of data, formulation and testing of hypotheses, and experimentation in the life sciences	S3		
…				
3.0	**Values, autonomy, and responsibility**			
3.1	work independently and as part of a team to finish some assignments.	V1		
3.2	Awareness about conservation natural biodiversity	V2		
…	Advocate for ethical practices and life sustainability	V3		

C. Course Content

No	List of Topics	Contact Hours
	Theoretical Topics	
1.	**Introduction into biology** * The Cell (History, Theory) * Prokaryotic and Eukaryotic structure * Types of Cells (Plant and animal)	2
2.	**Cell Biology** * Protoplasmic components *Non-protoplasmic components *Secondary compounds (Alkaloids, Glycosides, Tannins, Latex, organic acids, salts). * Metabolism	2
3.	**Genetics and Molecular Biology** * Structure and function of DNA and RNA * DNA replication, transcription, and translation * Biotechnology (Genetic engineering, cloning)	2
4.	**Systematics** • Two Kinds of Systematics; Taxonomy & Phylogeny • Role of Binomial nomenclature Diversity of life-forms	2
5.	**Domains of Life I** * Prokaryotes (bacteria and archaea) * Viruses and prions * Protists and fungi	2
6.	**Domains of Life II** * Plant diversity and adaptations * Animal diversity and classification	2
7.	**Plant Biology** * Plant structure and function * Photosynthesis and plant metabolism	2
8.	**Plant Biology** * Growth, hormones, and development * Reproduction in plants (pollination, seed dispersal)	2
9.	**Animal Physiology and Homeostasis** * Nervous system and endocrine system * Circulatory and respiratory systems * Digestive and excretory systems	2
10.	**Animal Physiology and Homeostasis**	2

	* Immune system and disease * Reproductive system and development	
11.	**Environmental pollution** *The concept of environmental pollution * Types, risks and controlling	2
12.	**Ecology and Environmental Biology** * Community interactions (competition, predation, symbiosis) * Ecosystem structure and energy flow (food chains, food webs, trophic levels) * Biomes and global climate change * Conservation biology and sustainability	2
13.	**Environmental Sustainability & Biodiversity Conservation in Saudi Arabia** * Desert greening projects: Using plant biology and biotechnology to combat desertification. * Coral reef and marine biodiversity conservation: Protecting the Red Sea's unique marine life.	2
14.	**Environmental Sustainability & Biodiversity Conservation in Saudi Arabia** * Wildlife conservation programs: Protecting endangered species like the Arabian leopard. * Renewable bio-based industries: Promoting sustainable biofuels and biodegradable materials.	2
15.	**Agriculture and Food Security** * Genetically modified crops (GMOs) to improve yield and resistance to extreme climates. * Sustainable aquaculture to increase seafood production in Saudi Arabia. * Vertical farming and hydroponics for efficient urban food production. * Biological pest control to reduce dependence on chemical pesticides.	2
	Total	**45**
	Practical Topics	**Contact Hours**
1	Biology Lab Safety -Lab Notebook -Basic Biology -Laboratory Equipment	3
2	Scientific Investigation Laboratory	3
3	Microscopes and Cells Laboratory	3
4	The Cell -Prokaryotic and Eukaryotic structure -Types of Cells (Plant and animal)	3

	-Protoplasmic components,	
5	Non-protoplasmic components of cell	3
6	Diffusion and Osmosis Laboratory	3
7	Mitosis And Meiosis laboratory	3
8	Domains of Life I -Prokaryotes (bacteria and archaea) - Viruses -Protists and fungi	3
9	Midterm exam	3
10	Domains of Life II -Plant & Animal diversity and classification	3
11	Bacteriology laboratory -Investigating Characteristics of Microorganisms Including Bacteria -Bacteria in the Environment, -Controlling the Growth of Bacteria	3
12	Cellular Respiration and Fermentation Laboratory	3
13	Photosynthesis Laboratory	3
14	Plant Growth Laboratory	3
15	Animal Physiology -Nervous system and endocrine system -Circulatory and respiratory systems -Digestive and excretory system	3
	Total	**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Exams (mid & final) theoretical & practical	7 & 13	70%
2.	Quizzes (1 & 2)	3 & 9	20%
3.	Student individual reports or work	final	10%
...	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Campbell Biology, 12th Edition, Author(s): Lisa A. Urry, Micheal L. Cain, Steven A. Wasserman, Peter V. Minorsky, Rebecca B. Orr, Neil A. Campbell, Publisher: Pearson, Year: 2020, ISBN: 9780135988046; 0135988047 Investigating Biology Laboratory Manual, Ninth Edition by Judith Giles Morgan, Emory University, and M. Eloise Brown Carter, Oxford College of Emory University 978-0-13447346-8/0- 134-47346-9
Supportive References	1. Handouts and Lecture notes 2. Microsoft office package. 3. Multi- media associated with the textbook and the relevant websites.
Electronic Materials	https://www.edx.org/
Other Learning Materials	https://www.coursera.org/learn/Biology

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1. Lecture room suitable for 40 students. 2. Lecture room equipped with Data show. 3. Biology laboratory.
Technology equipment (projector, smart board, software)	1. Computers or internet connection. 2. Active Board. 3. Data show is required in every room
Other equipment (depending on the nature of the specialty)	Laboratory instruments & equipment: light microscope, Spectrophotometer, centrifuge, pH meters, flasks, beakers, screw capped tubes, slides and tips and chemicals kits.

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Course lecturer	direct
Effectiveness of Students assessment	Course lecturer	direct
Quality of learning resources	Course lecturer	direct
The extent to which CLOs have been achieved	Course lecturer	direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

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2024
TP-153

Course Specification
(Bachelor)

Course Title:	General Physics 1
Course Code:	PHYS1101
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	13/1/2025

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐ University	☒ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (Level 1)					

4. Course General Description:

The course will cover the principles of general physics, such as measurements, vectors, Motion in one dimension, Newton's laws and fluids. The course will also provide a conceptual background of experimental physics sufficient to enable students to take courses that are more advanced in related fields.

5. Pre-requirements for this course (if any)**:**

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

After completing this course student should be able to deal with the following concepts:

1. measurements, length, time, and weight.
2. vectors and the scalars
3. vectors sum, and vectors product.
4. force and gravity.
5. Newton's laws of motion (to calculate the position, velocity and acceleration).
6. Fluids statics and dynamics.
7. Work, Energy, and power.
8. In addition to these items, the students should gain practical skills through performing some experimental class.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%

No	Mode of Instruction	Contact Hours	Percentage
2	E-learning	-	-
3	Hybrid ● Traditional classroom ● E-learning	-	-
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	describe concepts of units and measurements	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Distinguish between scalar and vector quantity	K2		
…				
2.0	**Skills**			
2.1	Relate motion to its constraints such as friction and drag force	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Apply Newton's law to solve problems	S2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.3	Analyze motion variables in multiple dimensions theoretically and experimentally	S3		
2.4	Solve problems in fluid statics and dynamics			
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Measurement ● Measuring Things ● The International System of Units ● Changing Units ● Length ● Significant Figures and Decimal Places ● Time ● Mass	4
2.	Motion Along a Straight Line ● Position, Displacement, and Average Velocity ● Motion ● Position and Displacement ● Average Velocity and Average Speed ● Instantaneous Velocity and Speed ● Acceleration ● Constant Acceleration: A Special Case ● Another Look at Constant Acceleration ● Free-Fall Acceleration ● Graphical Integration in Motion Analysis	5
3.	Vectors ● Vectors and Their Components ● Vectors and Scalars ● Adding Vectors Geometrically ● Components of Vectors ● Unit Vectors Adding Vectors by Components ● Vectors and the Laws of Physics ● Multiplying Vectors	4

4.	Motion in Two and Three Dimensions • Position and Displacement • Position and Displacement • Average Velocity and Instantaneous Velocity • Average Acceleration and Instantaneous Acceleration • Projectile Motion • Uniform Circular Motion • Relative Motion in One Dimension • Relative Motion in Two Dimensions	5
5.	Force and Motion-I • Newtonian Mechanics • Newton's First Law • Force • Mass • Newton's Second Law • Some Particular Forces • Newton's Third Law • Applying Newton's Laws	5
6.	Force and Motion-II • Friction • Properties of Friction • The Drag Force and Terminal Speed • Uniform Circular Motion Forces	3
7.	Fluids • What is Fluid? • Density and Pressure • Fluids at Rest • Measuring Pressure • Pascal's Principle • Archimedes' Principle • Ideal Fluids in Motion • The Equation of Continuity • Bernoulli's Equation • Viscosity	4
8.	Practical Part: Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract results, and prepare a written report every week.	45
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8th week	20%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	End of term	10%
5.	Final Exam	End of term	50%
...	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Halliday & Resnick, Jearl Walker, "Fundamentals of Physics" 10th Edition (2018)
Supportive References	Physics for Scientists & Engineers with Modern Physics 4th Edition by Douglas Giancoli, 4th Edition (2014).
Electronic Materials	Physics is Beautiful | Free, interactive physics lessons Khan Academy Physics | Physics videos The Feynman Lectures on Physics PhET Simulations | Online physics simulations
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory • Library
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	• Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire (direct)
Effectiveness of Students assessment	Instructor	Peer review of exam marking (direct)
Quality of learning resources	Instructor	Course report (direct)
The extent to which CLOs have been achieved	Instructor	Course report (direct)
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)
Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Calculus 1
Course Code:	MTH1101
Program:	Bachelor of Mathematics
Department:	Mathematics
College:	Sciences
Institution:	Umm Al-Qura University
Version	47
Last Revision Date:	25/01/2025

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
3 hours					
2. Course type					
A.	☐University	☒ College	☐ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (second level)					
4. Course General Description:					
It introduces a single-variable differential calculus. Key topics of the course include precalculus, limits, continuity, derivatives, rules for finding derivatives, and integration.					
5. Pre-requirements for this course (if any)**:**					
None					
6. Co-requisites for this course (if any)**:**					
N/A					
7. Course Main Objective(s):					
The primary objective of the course is to introduce students to the concepts of calculus and to develop students' confidence and skills in dealing with mathematical expressions. To achieve this goal, the course will help students understand the following basic concepts: limits, continuity, derivatives, and integration involving real-valued functions of one variable (including algebraic and trigonometric functions)					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	%100
2	E-learning	-	-
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning	-	-

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3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	43
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (Exam)**	2
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Determine the existence of limits of functions and use the limit properties to evaluate them.**	**K1**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
1.2	**Recognize infinite limits, and limits at infinity.**	**K1**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
...				
2.0	**Skills**			
2.1	**Find sets of solutions for equations and inequalities in one variable**	**S2**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
2.2	**Investigate the continuity of a function at a point and on intervals.**	**S4**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
2.3	**Evaluate the derivatives of a function using the limit definition and the differentiation rules.**	**S2**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
2.4	**Apply the Fundamental Theorem of Calculus.**	**S1**	**Lectures, Blackboard, Assignments**	**Exams, quizzes, Homework**
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	**Effectively manage their time to meet deadlines in both individual and group tasks.**	**V1**	**Assignments**	**Homework**
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Pre-Calculus:** Prepares students with the foundational concepts necessary for the study of calculus. Topics include a review of key mathematical principles, 2D geometry (lines and circles), and trigonometric functions along with their properties.	**14**
2.	**Limits and Continuity:** Introduction to Limits, Theorems on limits, Limit at infinity and infinite limits, Continuity.	**10**
3.	**Differentiation**: Definition of Derivative (Using Limits), Rules and Theorems for Finding Derivatives, Derivative of Trigonometric Function, Chain Rule, Higher Order Derivatives, Implicit Differentiation.	**12**
4.	**Integration:** Antiderivatives, Fundamental Theorems of Calculus.	**6**
5.	**Others:** Quizzes, Revision and Activities, Exam …	**3**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Midterm Exam**	**8th or 9th**	**%30**
2.	**Homework, Quizzes and Assignments**	**Continuous**	**%20**
...	**Final Exam**	**17th or 18th**	**%50**

*

Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Purcell, E. J., Varberg, D. and Rigdon, S. E. (2007). *Calculus (9th Edition).*
Supportive References	George B. T. *Thomas' Calculus (14th Edition).* S. James, R. Lothar and W. Saleem . (2010) *Precalculus: Mathematics for Calculus* (6th Edition)
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms** •
Technology equipment (projector, smart board, software)	• **Data Show**
Other equipment (depending on the nature of the specialty)	• **Black board**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of Students assessment	Instructor	Direct
Quality of learning resources	Students	Direct
The extent to which CLOs have been achieved	Instructor	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
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DATE	

Ministry Of Education Umm Al-Qura University وزارة التعليم جامعة أم القرى
كلية العلوم
قسم الفيزياء

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Linear Algebra 1
Course Code:	MTH1111
Program:	Bachelor of Mathematics
Department:	Mathematics Departement
College:	Sciences
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	18/01/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours:					
4 hours					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Second Level / First Year)					
4. Course General Description:					
Linear Algebra 1 typically serves as an introductory course to the field of linear algebra, which is a branch of mathematics focused on system of linear equations, matrices, vectors, vector spaces, and linear mappings between these spaces, along with eigenvalues and eigenvecors. The course provides foundational knowledge and concepts that are widely applicable in pure mathematics, applied sciences, computer science, and engineering.					
5. Pre-requirements for this course (if any)**:**					
Fondations of Mathematics (MTH1201)					
6. Co-requisites for this course (if any)**:**					
Not Applicable					
7. Course Main Objective(s):					
The main objective of studying linear algebra 1 is to gain a deep understanding of the mathematical framework used to model and solve problems involving linear systems, vector spaces, and linear transformations. This knowledge forms the basis for many areas mathematics, science, engineering, and beyond. The objectives can be broken downs as follows:					

- Develop the skills to solve systems of linear equations, which are common in various fields such as physics, econonmics, computer science.
- Study concepts like vector spaces, which are fundamental for problem-solving in many disciplines.
- Learn about linear transformations, which map vectors from one space to another while preserving vecor operations.
- Understand eigenvalues and eigenvectors to learn for example how diagonlization of matrices simplifies calculations and helps later to understand the behavior of systems.
- Build a foundation for advanced topics. Precisely, provide a solid foundation for more advanced mathematical fields such as abstract algebra, Linar algebra 2, and differential equations.
- Enhance problem solving and logical reasoning skills.
- Strenghen analytical, enabling the ability to understand and prove abstract mathematical concepts.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	100%
2	E-learning	0	0
3	Hybrid • Traditional classroom • E-learning	0	0
4	Distance learning	0	0

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	58
2.	**Laboratory/Studio**	0
3.	**Field**	0
4.	**Tutorial**	0
5.	**Others (specify): Midterm Exam**	2
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	**Solve systems of linear equations using substituting, elimination methods, matrix representation AX=b, and row reduction techniques.**	**K1**	**Lectures**	**Exams, Homeworks**
1.2	**Compute inverses and determinants of matrices using different methods.**	**K2**	**Lectures**	**Exams, Homeworks**
1.4	**Recognize vector spaces, subspaces, and their properties. Characterize linearly independent vectors, linearly dependent vectors, and spanning property of sets of vectors, find a transition matrix between bases, and compute a basis and the dimension of a vector space.**	**K2**	**Lectures**	**Exams, Homeworks**
1.5	**Compute the matrix representation of a linear transformation, kernal and range of a transformation.**	**K1**	**Lectures**	**Exams, Homeworks**
1.6	**Calculate the characteristic polynomial of a matrix and find its eigenvalues, eigenvectors, and eigenspace.**	**K2**	**Lectures**	**Exams, Homeworks**
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Apply mathematical concepts, techniques and theorems to solve problems.	S1	Lectures	Exams, Discussions, Homeworks
2.2	Use appropriate mathematical formulas and techniques to process the information and draw the relevant conclusion.	S7	Lectures	Exams, Discussions, Homeworks
3.0	Values, autonomy, and responsibility			
3.1	Train students to think abstractly and logically, enabling them to approach complex problems systematically and to develop a structured problem-solving mindest.	V1	Lectures	Exams, Discussions, Homeworks
3.2	Provides a universal language for interdisciplinary collaboration: Engineers, data scientists, economists, and physicists often use linear algebra concepts to communicate and solve problems together effectively.	V2	Lectures	Exams, Discussions, Homeworks

C. Course Content

No	List of Topics	Contact Hours
1.	Linear Equations and Systems: - System of linear equations - Solutions: consistent, inconsistent, unique, infinite solutions - Row eeduction and echelon forms - Gaussian and Gauss-Jordan elimination	12
2.	Matrices and Determinants:	12

	- Definintion and types of matrices (square, diagonal, identity, elementary, etc.) - Matrix operation: addition, multiplication, scalar multiplication - Transpose of of a matrix - Determinants: properties, computation, and applications - Minors and Cofactors - Inverse of a matrix (via adjoint or row reduction)	
3.	Vecors and Vector Spaces: - Definition of vectors - Operations: addition, scalar multiplication - Vector spaces and subspaces - Linear cominations and spans - Basis and dimension	12
4.	Linear Independence - Definition of linear idependence and dependence - Relation to basis and spans	8
5.	Linear Transformations - Definitions and examples - Kernal and range	6
6.	Eigenvalues and eigenvectors: - Definition and properties - Characteristic polynomial	6
7.	Others: Revision and activities, Exam, quizzes	4
Total		60

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm exam	8th or 9th	30%
2.	Homework and assignments	Continuous	20%
3.	Final Exam	17th or 18th	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**R. Larson, B. Edwards and D. C. Falvo.** (2008). Elementary Linear Algebra (6th edition). Brooks Cole.
Supportive References	**Assiry, A. Baklouti**. (2024). Simplicity in Linear Algebra (1st edition). Umm Alqura University. **G. Strang. (2016). Introduction to Linear Algebra (5th edition). Wellesley, MA: Cambridge Press.**
Electronic Materials	- Wolfram (website for mathematica software). - Scientific software like Matlab, Maple, Mathematica etc. - MIT OpenCourseWare – Linear Algebra (18.06): Features lecture notes, assignments, and exams from MIT's Linear Algebra course, including "ZoomNotes" by Professor Gilbert Strang. https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/download/
Other Learning Materials	None

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms**
Technology equipment (projector, smart board, software)	• **Projector** • **Black bord**
Other equipment (depending on the nature of the specialty)	**Not Applicable**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of Students assessment	Instructor (Faculty member)	Direct
Quality of learning resources	Students and Faculty member	Direct
The extent to which CLOs have been achieved	Instructor (Faculty member)	Direct

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
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Education & Training Evaluation Commission

اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Calculus 2
Course Code:	MTH1102
Program:	Bachelor of Mathematics
Department:	Mathematics
College:	Sciences
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	25/01/2025

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4 hours)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: Third level /Second year					
4. Course General Description:					
This course provides study of definite and indefinite integrals, transcendental functions, techniques of integration, geometric applications of definite integrals, improper integrals, sequences, and series.					
5. Pre-requirements for this course (if any)**:**					
Calculus 1 (MTH1101)					
6. Co-requisites for this course (if any)**:**					
Not applicable					
7. Course Main Objective(s):					
The primary objective of the course is to introduce students to the concepts of calculus and to develop their skills in working with mathematical expressions. In addition, students will learn systematic procedures for tackling unfamiliar integrals. Among the objectives, we can include understanding the role of definite integrals in calculating the volumes and surface areas of solids.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	%100
2	E-learning	-	-
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning	-	-

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	58
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (Exam)**	2
Total		60

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	develop knowledge and understanding principles of integral and apply the Fundamental Theorem of Calculus	**K1**	**Lecture**	**Exams, quizzes**
1.2	Distinguish methods for approaching integration problems	**K2**		
2.0	**Skills**			
2.1	Apply mathematical techniques to calculate integrals over infinite intervals	**S1**	**Lecture/Individual or group work**	**Exams, Quizzes, Homework**
2.2	Analyze mathematical methods to approaching integration problems	**S2**		
2.3	Apply the definite integral in geometry and engineering, solve these problems and interpret the solutions	**S5**		
3.0	**Values, autonomy, and responsibility**			
3.1	Working effectively in groups, demonstrating communication skills and time management	**V2**	**Lecture/Individual**	**Exams, Quizzes, Homework**

C. Course Content

No	List of Topics	Contact Hours
1.	**Integration:** antiderivatives, the definite integral, the first and second fundamental theorem of calculus and the method of substitution, the mean value theorem for integrals and the use of symmetry	**10**
2.	**Transcendental functions:** natural logarithm, inverse functions and their derivatives, natural exponent function, general exponent and logarithm functions, inverse trigonometric functions and their derivatives, and hyperbolic functions and their inverses.	**14**
3	**Techniques of integration:** basic integration rules, integration by parts, some trigonometric integrals, rationalizing substitutions, integration by parts, and integration of rational functions using partial functions	**14**
4	**Indeterminate forms:** type 0/0, other forms, L'Hôpital's rule, improper integrals: infinite limits of integrals, and infinite integrals	**10**
5	**Applications of the definite integral:** areas of plane region, volumes of solids, volume of solids of revolution, and length of plane curve.	**8**
6	Others (Problem Solving, midterm exam and quizzes)	**4**
	Total	60

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Midterm Exam**	**8th or 9th**	**%30**
2.	**Homework, Quizzes and Assignments**	**Continuous**	**%20**
...	**Final Exam**	**17th or 18th**	**%50**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Purcell, E. J., Varberg, D. and Rigdon, S. E. (2007). *Calculus (9th Edition).* Pearson/Prentice Hall.
Supportive References	George B. T. *Thomas' Calculus (14th Edition)*. S. James, R. Lothar and W. Saleem . (2010) *Precalculus: Mathematics for Calculus* (6th Edition)
Electronic Materials	

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• **Classrooms** •
Technology equipment (projector, smart board, software)	• **Projector** • **Data Show**
Other equipment (depending on the nature of the specialty)	• **Black bord**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of Students assessment	Instructor	Direct
Quality of learning resources	Students	Direct
The extent to which CLOs have been achieved	Instructor	Direct
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
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Education & Training Evaluation Commission

2023
TP-153

Course Specification
(Bachelor)

Course Title:	Anatomy and physiology
Course Code:	BIO 1301
Program:	Medical physics
Department:	Physics
College:	Faculty of science
Institution:	Umm Al-Qura University
Version:	1
Last Revision Date:	16-02-2025

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A. General information about the course:

1. Course Identification

1. Credit hours: 3 (2+1)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required			☐Elective	
3. Level/year at which this course is offered: (Level 2 /1nst year)					

4. Course general Description:

1.This course is interested in studying and recognize the meaning & importance of anatomy and physiology and its impact & complementary for other health related sciences.
2.By the end of this course the students are expected to understand the normal functions and the anatomical structures of body organs and systems.
3.In addition students will acquire skill to deal with the common lab problems and situations facing them along their practical life followers of the physiological bases.

5. Pre-requirements for this course (if any)**:**

General biology

6. Pre-requirements for this course (if any)**:**

Anatomy and physiology lab.

7. Course Main Objective(s):

The students are expected to understand the normal functions and the anatomical structures of body organs and systems. upon which they will be able to build the further knowledge they will learn in later years.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30 hrs.
2.	**Laboratory/Studio**	45 hrs.
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		75 hrs.

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Describe the general body organization and anatomical terminology.	K1	Introductory lecture gives an overview of the content and significance of the course and of its relationship to students' existing knowledge. Lectures Seminars	1.Homework Interactive 2.discussion 3.Short exam 4-Final exam
1.2	Describe the structure and function of cell, tissues, skin, skeletal system, muscular system, blood and cardiovascular system	K2		1.Presentations 2.Quizzes 3.. Problem solving
2.0	**Skills**			
2.1	Explain in-depth understanding the principles of anatomy and physiology and their interrelationships.	S1 &S2	Lecture Debate Small group work Group discussion Lab demonstrations	Exam must contain questions that can measure these skills.

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
2.2	Interpret a basic understanding of the integration of organ systems to maintain homeostasis	S3	Brain storming	Quiz and exams Discussions after the lecture
3.0	**Values, autonomy, and responsibility**			
3.1	Appraise the cooperation through teamwork to make a decision.	V1	Case Study - Active learning	Evaluate the scientific values of reports. Evaluate the work in team
3.2	Work dynamically as a team member and be effective in sharing ideas and engaging in fruitful discussion.	V1	Homework (preparing a report on some topics related to the course depending on web sites).	Evaluate the efforts of each student in preparing the report. Evaluation of student presentations

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C. Course Content

No	List of theoretical Topics	Contact Hours
1.	**1. Cells, tissues and organs** The cell membrane Cell-eating and drinking Cytoplasm The nucleus and DNA Cell division Mitochondria and cellular respiration Tissue types Epithelial cells Connective tissue Dense and specialized connective tissue Muscle tissue Voluntary muscle Smooth muscle Cardiac muscle Nervous tissue Organs and organ systems	3
2.	**Skeletal system Muscle** Organisation of skeletal muscles Skeletal system Skull and sinuses Spine and ribs Ossicles and hyoid bone Appendicular skeleton Foot bones Bone tissue Ossification Growth plates Bone structure Compact and spongy bone	3

	Bone marrow	
3.	**Blood** Plasma Plasma proteins Blood cell differentiation Haemoglobin Carbon monoxide Erythrocytes Erythropoiesis ABO blood types and transfusion	3
4.	**Immunity** Types of immunity Skin and secretions Commensals Mucus Self and non-self Parasites Toxoplasma gondii Worms Fungus and yeast Bacteria Viruses	3
5.	**Cardiovascular system** Circulation Arteries and veins Capillaries Hydrostatic pressure Fluid exchange The heart Pericardium Myocardium and endocardium	3

	Four chambers, four vessels, four valves Right side of the heart Left side of the heart Aorta The cardiac cycle	
6.	**Respiratory system** Lungs Respiration Air and altitude Partial pressure Airways Nasal cavity Warming and humidifying Pharynx Eustachian drainage Oropharynx Larynx Speech Trachea	3
7.	**Renal system** Urinary tract Kidneys Drainage Nephron Filtration Reabsorption Secondary active transport Water and glucose transport Secretion and hydrogen ions Urine Fluid balance	3
8.	**Digestive system**	3

	Metabolism Carbohydrate Fibre and protein Fats and cholesterol Vitamins and minerals Hunger and satiety Leptin and body mass index The peritoneum Gastric smooth muscle and mucosa The mouth and salivary glands Swallowing Stomach Gastric secretions	
9.	**Nervous system** Central nervous system Peripheral nervous system Motor and sensory nerves Neurons Action potentials Synapses and neurotransmitters Microglia, ependymal cells, satellite cells and Schwann cells Neuron damage Pain transmission	3
10.	**Endocrine system & Reproductive system** Hormones Receptors Hypothalamus Anterior pituitary hormones Thyroid Adrenal gland	3

	Male reproductive system Female reproductive system	
No	**List of practical Topics**	**Contact Hours**
1	**Human anatomy (Tissue type)**	**3**
2	**Anatomy of Digestion system in human**	**3**
3	**Digestion of starch by Salivary Amylase enzyme+ (Fehling's solution test-confirmation experiment)**	**3**
4	**Gastric juice (Pepsin enzyme test+ Renin enzyme test)**	**3**
5	**Pancreatic juice (Trypsin enzyme test)**	**3**
6	**Pancreatic juice (Lipase enzyme test)**	**3**
7	**Anatomy of Kidney in human**	**3**
8	**Urine Analysis experiments (1)**	**3**
9	**Urine Analysis experiments (2)**	**3**
10	**Abnormal urine experiment (diabetes)**	**3**
11	**Abnormal urine experiment (protein-bile pigments)**	**3**
12	**Glucose tolerance test (GTT)**	**3**
13	**Anatomy of Respiratory system in human**	**3**
14	**Using a spirometer to investigate human lung function**	**3**
15	**Final Exam (Lab)**	**3**
	Total	**75 hrs.**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Exercises & Homework, Quiz	All weeks	**10%**
2.	Exam Midterm (Lecture)	**7**	**20%**
3.	Lab weekly activities	All weeks	**10%**
4.	Final Exam (Lab)	**15**	**10%**
5.	Final Exam (theoretical)	**17**	**50%**
6.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Human Biology 16th Edition Sylvia Mader and Michael Windelspecht McGraw-Hill Education ISBN:9781260233032

	2-Introduction to anatomy and physiology for healthcare students David Sturgeon 2018 by Routledge ISBN: 978-1-138-68386-0
Supportive References	
Electronic Materials	List Electronic Materials Web Sites, Facebook, Twitter, etc. www.pubmed.com http://www.innerbody.com www.inner body.com www.Bartleby.com www.en.wikipedia.org/wiki/anatomy www.mic.ki.se/anatomy
Other Learning Materials	Multimedia associated with the textbooks and the relevant websites Lecture notes Acland's video

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (projector, smart board, software)	Data show, Smart Board
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct
Effectiveness of Students assessment	Staff and student	Direct
Quality of learning resources	Students	Direct, Indirect
The extent to which CLOs have been achieved	independent member teaching staff	Direct, Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Biology Program Update Committee - Biology Department - Faculty of Sciences
REFERENCE NO.	

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Course Specification
(Bachelor)

Course Title:	General Physics 2
Course Code:	PHYS1102
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	13/1/2025

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A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (Level 1)					

4. Course General Description:

The course will cover the principle of mechanics, such as kinetic and potential energies, collisions, rotational motion, fluid mechanics, and elasticity.

5. Pre-requirements for this course (if any)**:**

General Physics 1

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

After completing this course student should be able to deal with the following concepts:

1. work, kinetic energy, and potential energy.
2. the center of mass.
3. motion of a circular path.
4. torque and angular momentum.
5. the gravitation.
6. Images
7. In addition to these items, the students should gain practical skills through performing some experiments.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning	-	-

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid ● Traditional classroom ● E-learning	-	-
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Relate the variables of linear and rotational motion to each other.	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Define the theories of Center of mass and linear momentum	K1		
1.3	Differentiate between kinetic energy, potential energy, and Work	K3		
…				
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Solve problems in torque and angular momentum	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Apply physics laws to Equilibrium and Elasticity problems	S2		
2.3	Analyze the results of experiments	S3		
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Kinetic Energy and Work** ● Definition of Energy ● Kinetic Energy ● Work ● Work and Kinetic Energy ● Work Done by the Gravitational Force ● Work Done by a Spring Force ● Work Done by a General Variable Force ● Power	5
2.	**Potential Energy and Conservation of Energy** ● Work and Potential Energy ● Path Independence of Conservative Forces ● Determining Potential Energy Values ● Conservation of Mechanical Energy ● Reading a Potential Energy Curve ● Work Done on a System by an External Force ● Conservation of Energy	5
3.	**Center of Mass and Linear Momentum** ● The Center of Mass ● Newton's Second Law for a System of Particles ● Linear Momentum ● The Linear Momentum of a System of Particles ● Collision and Impulse ● Conservation of Linear Momentum ● Momentum and Kinetic Energy in Collisions ● Inelastic Collisions in One Dimension	6

	• Elastic Collisions in One Dimension • Collisions in Two Dimensions • Systems with Varying Mass: A Rocket	
4.	**Rotation** • Rotational Variables • Are Angular Quantities Vectors? • Rotation with Constant Angular Acceleration • Relating the Linear and Angular Variables • Kinetic Energy of Rotation • Calculating the Rotational Inertia • Torque • Newton's Second Law for Rotation • Work and Rotational Kinetic Energy	6
5.	**Rolling, Torque, and Angular Momentum** • Rolling as Translation and Rotation Combined • The Kinetic Energy of Rolling • The Forces of Rolling • The Yo-Yo • Torque Revisited • Angular Momentum • Newton's Second Law in Angular Form • The Angular Momentum of a System of Particles • The Angular Momentum of a Rigid Body Rotating About a Fixed Axis • Conservation of Angular Momentum • Precession of a Gyroscope	6
6.	**Equilibrium and Elasticity** • Equilibrium • The Requirements of Equilibrium • The Center of Gravity • Some Examples of Static Equilibrium • Indeterminate Structures • Elasticity	5
7.	**Gravitation** • Newton's Law of Gravitation • Gravitation and the Principle of Superposition • Gravitation Near Earth's Surface • Gravitation Inside Earth • Gravitational Potential Energy • Planets and Satellites: Kepler's Laws • Satellites: Orbits and Energy • Einstein and Gravitation	6
8.	**Images** • Reflection and Refraction • Total Internal Reflection • Two Types of Images • Plane Mirrors • Spherical Mirrors	6

	• Images from Spherical Mirrors • Spherical Refracting Surfaces • Thin Lenses • Optical Instruments	
9.	Practical Part: • Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week.	45

Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam (or 2 major exams)	8th week (or 4th and 10th)	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	End of term	10%
5.	Final Exam	End of term	50%
...	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Halliday & Resnick, Jearl Walker, "Fundamentals of Physics" 10th Edition (2018)
Supportive References	Physics for Scientists & Engineers with Modern Physics 4th Edition by Douglas Giancoli, 4th Edition (2014).
Electronic Materials	Physics is Beautiful | Free, interactive physics lessons Khan Academy Physics | Physics videos The Feynman Lectures on Physics PhET Simulations | Online physics simulations
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory

Items	Resources
	• Library
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	• Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire (direct)
Effectiveness of Students assessment	Instructor	Peer review of exam marking (direct)
Quality of learning resources	Instructor	Course report (direct)
The extent to which CLOs have been achieved	Instructor	Course report (direct)
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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Education & Training Evaluation Commission

اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Medical Physics	
Course Code: PHYM2101	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 7-12-2024	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 2/year 1)					
4. Course General Description:					
This course provides an introduction to the principles and applications of medical physics, emphasizing the role of physics in understanding and addressing medical challenges. Key topics include biomechanics, energy use, temperature regulation, pressure, sound and hearing, ultrasound, electricity in the body, optics and vision, ionizing radiation in diagnosis and therapy, radiobiology, and nuclear medicine. The course highlights the relevance of physics concepts to the development of major diseases, such as heart failure, sudden cardiac death, obstructive lung disease, and nerve conduction disorders. Students will explore the principles of medical imaging using X-rays, gamma rays, and ultrasound, and gain an understanding of radiobiology, including its implications for radiation sickness and the use of radiation therapy in medical treatments.					
5. Pre-requirements for this course (if any)**:**					
PHYS1101 General Physics (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course is designed to demonstrate the study of; 1- The motions of the living bodies as: static forces, friction, translational motion, angular motion, 2- Define the elasticity and strength of materials. 3- Acquire the basics of fluids, the motion of fluids, and body fluid flow. 4- Discuss the fundamentals of heat and life, kinetic theory, and thermodynamics. 5- Describe different types of waves, sound, electricity, and electrical technology. 6-Identify forces on bones and muscles, electrodynamics of nerve impulses, electrocardiograms, magneto cardiograms, and magnetoencephalograms. 7- List different diffusion processes, membrane transport, and kidney function. 8-Describe different biological effects in magnetic resonance and ultra-low frequency electromagnetic radiation, radiation therapy, and imaging. and laser applications.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	To recognize facts, principles, and concepts of elementary medical Physics	**K1, K2**	1. Demonstrating the basic principles through lectures. 2. Discuss phenomena by illustrating pictures and diagrams. 3. Lecturing method: ● Board, PowerPoint. ● Discussions ● Brainstorming Start each chapter with a general idea and its benefits of it.	Solve some examples during the lecture. Discussions during the lectures. Exams: a) Quizzes. b) Midterm exams. c) Final exam.
1.2	To understand the physical laws of human body equilibrium	**K1**		
1.3	Describe concepts and procedures of some experiments in medical physics	**K1, K2**		
2.0	**Skills**			
2.1	Apply the laws of medical physics.	**S1, S2**	1. Solve some problems in physics during lectures. 2. Following some proof during lectures. 3. Encourage students to participate in solving problems.	1. Solve some examples during the lecture. 2. Discussions during the lectures 3. Exams: a) Quizzes. b) Midterm exams. c) Final exam
2.2	Solving problems in Physics by using suitable mathematical principles	**S2**		
2.3	Analyses and interprets quantitative results	**S2**		
3.0	**Values**			
3.1	Collect and classify the material for a course	**V1, V2**	1. Group assignments 2. Clarify deadlines for assignments, reports, and exams.	1. Evaluate the efforts of each student in preparing the report. 2. Evaluate the work in teams. Evaluation of students presentations.
3.2	Use basic medical physics terminology in English	**V1, V2**		
3.3	Acquire the skills to use the internet communication tools.	**V2**		

Course Content

No	List of Topics	Contact Hours
1.	**Static force** 1 Equilibrium and Stability 2 Equilibrium Considerations for the Human Body 3 Stability of the Human Body under the Action of an External Force 4 Skeletal Muscles 5 Levers 6 The Elbow 7 Friction Standing at an Incline	6
2.	**Elasticity and Strength of Materials** 1 Longitudinal Stretch and Compression 2 A Spring 3 Bone Fracture: Energy Considerations 4 Impulsive Forces 5 Fracture Due to a Fall: Impulsive Force Considerations 6 Airbags: Inflating Collision Protection Devices 7-Whiplash Injury 8 Falling from Great Height 9 Osteoarthritis and Exercise.	6
3.	**The Motion of Fluids** 1 Bernoulli's Equation 2 Viscosity and Poiseuille's Law 3 Turbulent Flow 4 Circulation of the Blood 5 Blood Pressure 6 Control of Blood Flow 7 Energetics of Blood Flow 8 Turbulence in the Blood 9 Arteriosclerosis and Blood Flow 10 Power Produced by the Heart 11 Measurement of Blood Pressure	6
4.	**Waves and Sound** 1 Properties of Sound 2 Some Properties of Waves (Reflection, Refraction, Interference, Diffraction) 3 Hearing and the Ear (Performance, Frequency and Intensity and Loudness) 4 Bats and Echoes 5 Sounds Produced by Animals 6 Acoustic Traps 7 Clinical Uses of Sound 8 Ultrasonic Waves	6
5.	**Electricity** 1 The Nervous System 2 The Neuron 3 Electrical Potentials in the Axon 4 Action Potential 5 Axon as an Electric Cable 6 Propagation of the Action Potential 7 Synaptic Transmission .8 Action Potentials in Muscles 9 Surface Potentials 10 Electricity in Plants 11 Electricity in the Bone	6
6.	**Optics** 1 Vision. 2 Nature of Light 3 Structure of the Eye 4 Accommodation 5 Eye and the Camera 6 Lens System of the Eye 7 Reduced Eye .8 Retina 9 Resolving Power of the Eye. 10 Threshold of Vision 11 Vision and the Nervous System. 12 Defects in Vision. 13 Lens for Myopia. 14 Lens for Presbyopia and Hyperopia 15 Fiber Optics	6
7	**Atomic Physics** 1 The Atom 2 Spectroscopy 3 Quantum 4 Electron Microscope 5 X-rays 6 X-ray Computerized Tomography	3
8	**Nuclear Physics** 1 The Nucleus 2 Magnetic Resonance Imaging 3. Nuclear Magnetic Resonance 4. Imaging with NMR 5. Functional Magnetic Resonance Imaging (fMRI) 6. Radiation Therapy 7. Food Preservation by Radiation 8. Isotopic Tracers 9. Laws of Physics and Life Exercises	6
	Laboratory 1. The Human arm model—1	45

	2. The Human arm model—2 3. Fluids Motion (Simulation)-1 4. Fluids Motion (Simulation)-2 5. Doppler effect 6. Velocity of ultrasound in solid state materials 7. Electrocardiography (ECG) 8. Human Eye model -1 9. Human Eye model -2 10. X-ray photography: fogging of film due to x-rays 11. Radioactive Dating (Simulation)	
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. 1-Paul Davidovits "Physics in Biology and Medicine" 3rd edi. Elsevier 2008. 2. 2-Russell K. Hobbie & Bradley J. Roth "Intermediate Physics for Medicine and Biology" Springer Science 2007.
Supportive References	1. Introduction to Biological Physics for the Health and Life Sciences, 2nd Edition Kirsten Franklin, Paul Muir, Terry Scott, Paul Yates ISBN: 978-1-118-93450-0 2. John R. Cameron & James G. Skofronick "Medical physics" Willy John 1988
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**1- Classroom** **2- Library**
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students' assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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Education & Training Evaluation Commission

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NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Fundamentals of Electricity and magnetism
Course Code: PHYS3902
Program: Medical Physics
Department: Physics
College: Science
Institution: Umm Al-Qura University
Version: 47
Last Revision Date: 13/1/2025

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (5)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required			☐Elective	
3. Level/year at which this course is offered: (Level 1)					
4. Course General Description:					
This course will provide a conceptual background in physics sufficient to enable students to take courses that are more advanced in related fields. It covers the following: Electric charge, electric fields, superposition, Gauss' Law, surface integrals, electric flux, the electric potential, simple circuits, Ohm's Law, and capacitors, Magnetic Fields, Magnetic Fields Due to Currents.					
5. Pre-requirements for this course (if any)**:**					
General Physics 1 PHYS1101					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
After completing this course student should be able to: 1. Define the fundamental properties of the electric charge, solve technical problems associated with the electrostatic force (Coulomb force), 2. Identify and calculate the electric field at a point due to electric charge. 3. Relate the electric field and the electrostatic force on a charged particle. 4. Define and calculate the electric potential at a point. 5. Define and calculate the electric flux through a surface. 6. Define electric capacitance and solve technical problems . 7. Define electric current, current density, and solve technical problems involving DC networks of resistors, batteries, and capacitors, Ohm's Law, Kirchhoff's laws, and RC charging and decay circuits. 8. Define and calculate the magnetic field and magnetic flux due to passign of DC current through a ciruit. 9. In addition to these items, the students should gain practical skills through performing some experiments.					

2. Teaching mode (mark all that apply)

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No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning	-	-
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define the concepts of electric charge, Coloumb law, Electric field, Electric potential, Electric flux through a surface..	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Explain the phenomemna of electromagnetic induction.	K2		
...				
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Relate the currents, resistance, and potential diference in an electric circuit	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Calculate the magnetic field.	S2		
2.3	Analyze the results of experiments	S3		
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Coulomb's Law • Electric Charge, Conductors and Insulators, Coulomb's Law, Charge is quantized, Charge is conserved.	3
2.	Electric Fields • The Electric Field, Electric field lines, Electric Field Due to a Charged particle, Electric Dipole, The Electric Field Due to an Electric Dipole, Electric Field Due to a line of charge, The Electric Field Due to a Charged Disk, A Point Charge in an Electric Field, A Dipole in an Electric Field,	3
3.	Gauss' Law • Flux of an Electric Field, Gauss' Law, Gauss' Law and Coulomb's Law, A Charged Isolated Conductor, Applying Gauss' Law: Cylindrical Symmetry, Applying Gauss' Law: Planar Symmetry, Applying Gauss' Law: spherical Symmetry.	4

4.	Electric Potential ● Electric Potential, Electric Potential Energy, Equipotential surfaces, Calculating the potential from the field, Potential Due to a Point Charge, Potential Due to a group of Point Charges, Potential Due to an Electric Dipole, Potential Due to a Continuous Charge Distribution, Calculating the field from the potential, Electric Potential Energy of a System of Point Charges, Potential of a Charged Isolated Conductor.	4
5.	Capacitance ● Capacitors, Capacitance, Calculating the Capacitance, Capacitors in Parallel and in Series, Energy Stored in an Electric Field, Capacitor with a Dielectric. Dielectrics and Gauss' Law.	4
6.	Current and Resistance ● Electric Currents, Current density, Resistance and Resistivity, Ohm's Law, Power in Electric Circuits. Semiconductors, Superconductors.	3
7.	Circuits ● Single-Loop circuits, "Pumping" Charges, Work, Energy, and Emf, Calculating the Current in a Single-Loop Circuit, Other Single-Loop Circuits, Potential Difference Between Two Points, Multiloop Circuits (resistors in parallel and in series), The Ammeter and the Voltmeter, RC Circuits, Charging and Discharging a Capacitor. Sample problems.	3
8.	Magnetic Fields ● The source of a Magnetic Field The Definition of the Magnetic Field, Crossed Fields: Discovery of the Electron, Crossed Fields: The Hall Effect, A Circulating Charged Particle, Cyclotrons and Synchrotrons, Magnetic Force on a Current-Carrying Wire, Torque on a Current Loop, The Magnetic Dipole Moment.	3
9.	Magnetic Fields Due to Currents ● Calculating the Magnetic Field Due to a Current, Magnetic Field Due to a Current in a Long Straight Wire, Magnetic Field Due to a Current in a Circular Arc of Wire, Force Between Two Parallel Currents, Ampere's Law, Magnetic Field Outside a Long Straight Wire with Current , Magnetic Field Inside a Long Straight Wire with Current , Solenoids and Toroids, A Current-Carrying Coil as a Magnetic Dipole.	3

10.	Practical Part: • Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week.	45

Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8^{th} week	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	End of term	10%
5.	Final Exam	End of term	50%
...	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Halliday & Resnick, Jearl Walker, "Fundamentals of Physics" 10th Edition (2018)
Supportive References	Physics for Scientists & Engineers with Modern Physics 4th Edition by Douglas Giancoli, 4th Edition (2014).
Electronic Materials	Physics is Beautiful | Free, interactive physics lessons Khan Academy Physics | Physics videos The Feynman Lectures on Physics PhET Simulations | Online physics simulations
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory • Library
Technology equipment (projector, smart board, software)	• Blackboard • Projector

Items	Resources
Other equipment (depending on the nature of the specialty)	• Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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TP-153

Course Specification
(Bachelor)

Course Title: Introductory Modern Physics	
Course Code: PHYS3903	
Program: Medical physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 7/1/2025	

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hrs)					
2+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 3/ 2nd years)					
4. Course General Description:					
The course will cover the principles of Modern physics, such as Relativity, Particle Properties of Waves, Wave Properties of Particles, Atomic Structure, Many-Electron Atoms and Molecules. This course will provide a conceptual and experimental background sufficient to enable students to take courses that are more advanced in related fields.					
5. Pre-requirements for this course (if any):					
General physics 2 PHYS1102					
6. Co-requisites for this course (if any):					
7. Course Main Objective(s):					
After completing this course student should be able to deal with the following concepts: 1. Relativity 2. Particle Properties of Waves 3. Wave Properties of Particles 4. Atomic Structure 5. Molecules 6. In addition to these items, the students should gain practical skills through performing some experiments.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define relativity.	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Describe the atomic structure	K2		
2.0	**Skills**			
2.1	Calculate the electronic structure and quantum numbers for atoms	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Explain bonds and their types in Molecules.	S2		
2.3	Analyze experimental data	S3		
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	Work effectively individually or within a team	V1	Lectures and lab experiments	Exams and lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Relativity** Special Relativity, Time Dilation, Doppler Effect, Length Contraction, Twin Paradox, Electricity and Magnetism, Relativistic Momentum, Mass and Energy, Energy and Momentum and General Relativity.	6
2.	**Particle Properties of Waves** Electromagnetic Waves, Blackbody Radiation, The photoelectric effect, XRays, X-Ray Diffraction, Compton Effect, Pair Production and Photons and Gravity.	6
3	**Wave Properties of Particles** De Broglie waves, describing a Wave, Phase and Group Velocities, Particle Diffraction, Particle in a Box, Uncertainty Principle I, Uncertainty Principle II and Applying the Uncertainty Principle.	6
4	**Atomic Structure** The Nuclear Atom, Electron Orbits, Atomic Spectra, The Bohr Atom, Energy Levels and Spectra, Correspondence Principle, Nuclear Motion, Atomic Excitation and The Laser	6
5	**Molecules** The Molecular Bond, Electron Sharing, The H2 + Molecular Ion, The Hydrogen Molecule, Complex Molecules, Rotational Energy Levels, Vibrational Energy Levels, and Electronic Spectra of Molecules.	6
6.	**PRACTICAL PART** Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week.	45
Total		**75**

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D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8^{th} week	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4	Lab. Exam	End of term	10%
5	Final Exam	End of term	50%
6	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Arthur Beiser, "Concepts of Modern Physics", 6th Edition, McGrawHili Primls, (2003).
Supportive References	• J. Bernstein, Paul Fishbane and Stephen Gasiorowicz, Modern Physics, (2000, Hardcover).
Electronic Materials	• The website of the course
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exam
Quality of learning resources	Instructor	Course report

Assessment Areas/Issues	Assessor	Assessment Methods
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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2024
TP-153

Course Specification
(Bachelor)

Course Title	Theoretical Methods in Medical Physics
Course Code:	PHYS3904
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	13/1/2025

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 3/2nd year)					
4. Course General Description:					
This course provides a foundation in the essential theoretical methods used in physics, with a focus on applications relevant to medical physics. The emphasis of this course is on applications in solving problem in medical physics.					
5. Pre-requirements for this course (if any)**:**					
Calculus 2 MTH1102					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The objective of the course is to help students to develop skills and knowledge of standard concepts in theoretical physics, with a particular focus on applications relevant to medical physics. Through this course, students will develop the skills to analyze, model, and solve complex physical problems using theoretical techniques, thereby preparing them for advanced studies and professional work in medical physics and related fields. These methods include vectors, Fourier series and transforms, partial differential equations, probability and statistics, and numerical methods.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define vectors quantities and their properties.	K1	Lectures	Exams, homework and quizzes
1.2	Define Fourier series associated with simple functions and apply them to selected physical problems.	K1	Lectures	Exams, homework and quizzes
1.3	Identify mathematical model for many scientific and engineering problems involving partial differential equations.	K1	Lectures	Exams, homework and quizzes
2.0	Skills			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Apply Fourier and Laplace transforms to solve physics problems.	S1,S2	Lectures	Exams, homework and quizzes
2.2	Use partial differential equations to model wave, heat flow and related phenomena.	S1,S2	Lectures	Exams, homework and quizzes
2.3	Use the basic concepts of probability in medical physics.	S1,S2	Lectures	Exams, homework and quizzes
2.4	Apply the suitable method for interpolation and fit data in medical physics problems.	S1,S2	Lectures	Exams, homework and quizzes
3.0	**Values, autonomy, and responsibility**			
3.1				
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**VECTOR ANALYSIS** 1. Scalars and vectors 2. Addition and subtraction of vectors 3. Multiplication by a scalar 4. Basis vectors and components 5. Magnitude of a vector 6. Multiplication of vectors 7. Differentiation of vectors 8. Integration of vectors	**3**
2.	**FOURIER SERIES AND TRANSFORMS** 1. Simple Harmonic Motion and Wave Motion; Periodic Functions 2. Applications of Fourier Series 3. Average Value of a Function	**14**

	4. Fourier Coefficients 5. Dirichlet Conditions 6. Complex Form of Fourier Series 7. Other Intervals 8. Even and Odd Functions 9. An Application to Sound 10. Parseval's Theorem 11. Fourier Transforms	
3.	**PARTIAL DIFFERENTIAL EQUATIONS** 1. Laplace's Equation; Steady-State Temperature in a Rectangular Plate 2. The Diffusion or Heat Flow Equation; the Schrödinger Equation 3. The Wave Equation; the Vibrating String 4. Steady-state Temperature in a Cylinder 5. Vibration of a Circular Membrane 6. Steady-state Temperature in a Sphere 7. Poisson's Equation	**12**
4.	**PROBABILITY AND STATISTICS** 1. Sample Space 2. Probability Theorems 3. Methodsof Counting 4. Random Variables 5. Continuous Distributions 6. Binomial Distribution 7. The Normalor Gaussian Distribution 8. The Poisson Distribution 9. Statistics and Experimental Measurements	**10**
5.	**NUMERICAL METHODS** 1. Interpolation 2. Curve fitting 3. Examples	**6**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework and Quizzes**	**During the semester**	**20%**

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
2.	**Midterm Exams**	**5^{th} - 10^{th} week**	**30%**
3.	**Final Exam**	**End of the semester**	**50%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Mary L. Boas, Mathematical methods in the Physical sciences, Third edition, John Wiley and Sons (2006). ISBN-13: 978-0471198260 Mathematical Methods for Physicists: A Comprehensive Guide 7th edition, by George B. Arfken, Hans J. Weber, Frank E. Harris, Academic Press is an imprint of Elsevier (2013), ISBN-13: 978-0-12- 384654-9.
Supportive References	Mathematical Methods for Physics and Engineering, by K. F. Riley, M. P. Hobson, and S. J. Bence, Cambridge University Press; (2006), ISBN-13: 978-0521679718.
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classrooms
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct /Questionnaire**
Effectiveness of Students assessment	**Instructor**	**Direct /Exams**
Quality of learning resources	**Instructor**	**indirect /Course report**

Assessment Areas/Issues	Assessor	Assessment Methods
The extent to which CLOs have been achieved	Instructor	indirect /Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics department council
REFERENCE NO.	Minutes of session no. Xx
DATE	X/X/2025

Ministry Of Education
Umm Al-Qura University
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Course Specification
(Bachelor)

Course Title:	Optics and Waves
Course Code:	PHYS3905
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Um-Alqura University
Version:	47
Last Revision Date:	5/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 hrs)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required			☐Elective	
3. Level/year at which this course is offered: (3Th Year/Level 5)					
4. Course General Description:					
Waves theory of light: wave equation, sinusoidal waves, phase velocity, complex representation, and plane waves. Superposition of waves: superposition principle, superposition of waves of the same frequency, standing waves, phase and group velocities, energy and power. Interference: two-beam interference, Young's double-slit experiment, double-slit interference with virtual sources, interference in dielectric films, Newton's Rings. Optical Interferometer. Polarization, production of polarized light, double refraction (birefringence). Diffraction of light: types of diffraction, Fraunhofer diffractio, beam spreading, and resolution. Diffraction grating, grating equation, dispersion, types of grating and grating.					
5. Pre-requirements for this course (if any)**:**					
General Physics 2 PHYS1102					
6. Co-requisites for this course (if any)**: None**					
7. Course Main Objective(s):					
After completing this course student should be able to deal with the following concepts: 1. Interference of light. 2. Diffraction of light. 3. Polaritzation 4. In addition to these items, the students should gain practical skills through performing some experiments.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Define the equation of oscillation, and traveling wave.	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Describe all types of interference of light	K2		
2.0	Skills			
2.1	Solve problems related to diffraction of light.	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Apply physics law to polarization phenomena.	S2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.3	Analyze experimental data	S3		
3.0	Values, autonomy, and responsibility			
3.1	Work effectively individually or within a team	V1	Lectures and lab experiments	Exams and lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to waves 1- oscillations equation. 2- Equation of traveling Wave.	6
2.	Interference 1- Young double slit 2- Double beam experiments 3- General conditions of interference 4- Superposition and Michelson interferometer 5- Plane parallel plates 6- Fabry - Perot interferometer and Newtons rings	8
3.	Diffraction grating 1- One dimension gratings. 2- Grating equation and angular dispersion. 3- Chromatic resolving power. 4- Two dimension grating. 5- X ray diffraction and Bragg's law	8
4.	Polarization 1. Types of polarized light 2. Production of polarized 3. Optical active phenomena 4. Polarization caused by electric and magnetic fields	8
5.	PRACTICAL PART Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week.	45
Total		75

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8th week	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	End of term	10%
	Final Exam	End of term	50%
	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Fundamentals of optics , by Francis Jenkins and Harvey White, Mc Graw Education, (2001)
Supportive References	• Optics (4th Edition) Hecht, Eugene. 2001.
Electronic Materials	• Physics is Beautiful | Free, interactive physics lessons • Khan Academy Physics | Physics videos • The Feynman Lectures on Physics • PhET Simulations | Online physics simulations
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory • Library
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	• Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

Course Specification

— (Bachelor)

Course Title: Fundamental of Nuclear Physics	
Course Code: PHYS3906	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 13/1/2025	

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 3/2nd year)					
4. Course General Description:					

This course is designed to introduce medical physics students to the fundamental principles and applications of nuclear physics, emphasizing concepts relevant to medical applications such as radiology, cancer treatment, and medical imaging. Over 15 weeks, students will explore the structure and behavior of nuclei, the forces that govern nuclear interactions, and the theoretical models that describe these phenomena. The course begins with an introduction to nuclear phenomenology, where students will learn about the basic properties of nuclei, including their labeling, masses, and dimensions. This foundation leads to a deeper understanding of nuclear stability and the forces at play within the nucleus, crucial for applications in medical imaging and radiation therapy. Students will also study various nuclear models such as the Liquid Drop Model, the Fermi-Gas Model, and the Shell Model, which provide insights into the energy states and behavior of nuclei under different conditions. These models are instrumental in understanding nuclear reactions, which are central to technologies like PET scans and MRI. The course will cover different types of nuclear decay processes—alpha, beta, and gamma decay—which are pivotal in nuclear medicine for both diagnostics and treatment. The course will particularly emphasize the practical and theoretical aspects of gamma decay due to its significance in medical imaging techniques. By the end of the course, students will have a robust understanding of the key principles of nuclear physics and their applications in the medical field. They will be equipped with the knowledge to engage with more advanced topics in medical physics and contribute effectively to the field through research or clinical practice. Teaching methods will include lectures, laboratory sessions, and problem-solving workshops, while assessment will be conducted through written exams, lab reports, and a final project that demonstrates the integration of nuclear physics principles with medical applications. This course aims to blend theoretical knowledge with practical skills, providing a comprehensive foundation for further study or professional development in medical physics.

5. Pre-requirements for this course (if any)**:**
Medical Physics PHYM2101
6. Co-requisites for this course (if any)**:**

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7. Course Main Objective(s):

1. Understand Nuclear Structure and Properties: Equip students with a thorough understanding of nuclear structure, including the properties and behaviors of nuclei, to form the basis for comprehending complex medical applications involving radiation and imaging.
2. Master Key Nuclear Models and Theories: Introduce and explain the core nuclear models such as the Liquid Drop Model, Fermi-Gas Model, and Shell Model. This will enable students to predict and analyze nuclear behavior, crucial for applications in radiation therapy and diagnostic imaging.
3. Explore Nuclear Stability and Decay: Educate students on the processes and principles of nuclear stability and decay, including alpha, beta, and gamma decays. Knowledge of these processes is essential for medical physics applications, such as radiotherapy and radiopharmaceuticals.
4. Apply Nuclear Physics Principles to Medical Technology: Demonstrate how nuclear physics principles are applied in medical technologies, including MRI, CT scans, and radiation therapy. This includes understanding the generation and manipulation of nuclear phenomena in a medical context.
5. Develop Problem-Solving Skills: Develop students' ability to apply theoretical knowledge of nuclear physics to solve practical problems encountered in medical physics. This includes both quantitative problem-solving and experimental design.
6. Foster Research and Ethical Thinking: Encourage a research-oriented approach, fostering curiosity and critical thinking, and instilling an appreciation of ethical considerations in the use of nuclear technology in medicine.
7. Prepare for Advanced Studies: Prepare students for further academic pursuits in nuclear physics or medical physics by providing a robust foundation and fostering an understanding of the ongoing research in these fields.

These objectives are designed to provide a comprehensive understanding of nuclear physics with a focus on applications that directly impact medical technology and treatment methods. They aim to prepare students not only academically but also for practical challenges in the field of medical physics.

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2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning	--	

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Identify the fundamental principles and models of nuclear physics.	K1	Lectures, readings, and multimedia presentations	Exams, homework, quizzes and Practical work
1.2	Describe the mechanisms of nuclear stability and decay processes.	K2	Lectures, readings, and multimedia presentations	
2.0	**Skills**			
2.1	Analyze and solve complex problems related to nuclear reactions and decays.	S1	Lectures, readings, Problem-solving sessions, practical labs, software simulations	Exams, homework, quizzes and Practical work
2.2	Apply mathematical and computational techniques to model nuclear phenomena.	S2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.3	Develop experimental skills through lab experiments and simulations.	S3		
3.0	**Values, autonomy, and responsibility**			

C. Course Content

No	List of Topics	Contact Hours
1.	**Introductory Remarks to Nuclear Phenomenology** - Overview of nuclear physics, its significance in science and technology.	2
2.	**Properties of Nuclei: Labeling and Masses** - Discussion on nuclear notation, magic numbers, isotopes, isotones and isobars, nuclear masses and binding energy concepts.	2
3.	**Sizes of Nuclei, Nuclear Spins and Dipole Moments** - Examination of nuclear sizes, charge radii, nuclear spin, magnetic and electric dipole moments.	2
4.	**Stability and Instability of Nuclei** - Analysis of nuclear stability, decay modes, beta stability line, and neutron-proton ratio.	2
5.	**Nature of the Nuclear Force** - Exploration of the nuclear force characteristics, range, and the Yukawa potential.	2
6.	**Introductory Remarks to Nuclear Models** - Introduction to nuclear models, historical context, and their importance.	2
7.	**Liquid Drop Model** - Detailed study on the macroscopic model of nucleus, liquid drop analogy, surface tension, and semi-empirical mass formula.	2
8.	**Fermi-Gas Model** - Analysis of the microscopic view of nucleons as a Fermi gas, Pauli exclusion principle, and energy states.	2
9.	**Shell Model: Infinite Square Well** - Introduction to quantum mechanical models, potential well theory, quantized energy levels.	2
10.	**Shell Model: Harmonic Oscillator** - Discussion on harmonic oscillator potential in nuclear context, quantization, and its applications in nuclear structure.	2
11.	**Shell Model: Spin-Orbit Potential** - Exploration of spin-orbit coupling, its origin, and implications for nuclear shell structure.	2
12.	**Predictions of the Shell Model and Collective Model** - Comprehensive review of shell model predictions, magic numbers, and introduction to collective excitations in nuclei.	2
13	**Nuclear Radiation: Alpha Decay, Barrier Penetration** - Overview of alpha decay, concepts of barrier penetration.	2
14.	**Beta Decay: Lepton Number, Neutrino Mass, The Weak Interaction** - In-depth discussion of beta decay processes, conservation of lepton number, neutrino properties, and weak interaction.	2

15.	**Gamma Decay** - Study of gamma decay, electromagnetic radiation from the nucleus, multipolarity, and selection rules.	2
16.	**Practical Part:** Students will conduct various experiments in the practical part of the course. Each student will perform the experiments, collect data, extract results, and prepare a written report every week.	45
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework & Quizzes	During the semester	10%
2.	Midterm exams	5^{th} - 10^{th} week	20%
3.	Laboratory work	Every week	20%
4.	Final Exam	End of semester	50%
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1.**“Introduction to Nuclear and Particle Physics"** by A. Das and T. Ferbel , 2nd edition, published by World Scientific in 2004. The print ISBN for this edition is 9789812387448, and the electronic version's ISBN is 9789812564351. 2.**"Modern Nuclear Physics"** *Authors:* Alexandre Obertelli and Gabriel Martínez-Pinedo, *Edition:* 1st Edition, *Year:* 2021 *ISBN:* 978-3030308830 3. “**Fundamentals of Nuclear Physics"** *Author:* Noboru Takigawa and Koji Yoshida, *Edition:* 1st Edition, *Year:* 2017 *ISBN:* 978-4431564578 4. **Krane, K.S., "Introductory Nuclear Physics",** 3rd Edition, John Wiley and Sons Inc., India, 2008. ISBN: 978-0471805533
Supportive References	1.**Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg. "Modern Nuclear Chemistry**", 2nd Edition, 2006, John Wiley & Sons, Inc. ISBN: 978-0471115328 2. **Nuclear and Particle Physics, B. R. Martin, 2006, John Wiley & Sons, Ltd.** ISBN: 978-0470025322.

Electronic Materials	https://world-nuclear.org/ http://www.lnhb.fr/home/nuclear-data/ https://www.nrc.gov/reading-rm/basic-ref/students/for-eductors
Other Learning Materials	--

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classrooms • Simulation Rooms: For visualizing quantum phenomena using computational tools.
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	**Students**	**Direct /Questionnaire**
Effectiveness of Students assessment	**Instructor**	**Direct /Exams**
Quality of learning resources	**Instructor**	**indirect /Course report**
The extent to which CLOs have been achieved	**Instructor**	**indirect /Course report**
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics department council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

Course Specification
(Bachelor)

Course Title:	Medical Radiation Physics (1)
Course Code:	PHYM4201
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (……….)					
4. Course General Description:					
This course focuses on the atomic & nuclear structure, main radioactive process, photon attenuation, photon, electron and neutron interactions.					
5. Pre-requirements for this course (if any)**:**					
PHYM3906 Fundamentals of nuclear physics					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
On completion of this course, students should be able to: - Describe the basic principles underlying different radioactive modes; - Explain the principles of different photon attenuation coefficients; - Perform basic photon attenuation calculations; - Explain main photon interactions; - Perform basic photon interaction calculations; - Explain main electron interactions; - Explain main neutron interactions;					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	Differentiate between various modes of radioactive decay.	**K1, K2**	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.2	Describe and differentiate between the various photon attenuation	**K2, K3**	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	coefficients used in radiation physics			Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.3				
2.0	**Skills**			
2.1	-Solve problems related to the photon attenuations and interactions	**S1, S2, S3, S4**	-Problem-solving strategy -Cooperative learning strategy	-Written test -Individual and group activities -Short cognitive tests. -Achievement tests
2.2	-Interpret the photon attenuation for different human types	**S1, S2**	-Problem-solving strategy	-Written test -Individual and group activities
...				
3.0	**Values, autonomy, and responsibility**			
3.1	- Apply knowledge of photon attenuation coefficients and interactions to make informed decisions in radiation safety and material selection.	**V1, V2, V3, V4**	-Flipped classroom -Cooperative learning	-Short quiz in class -Discussion in class
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Atomic structure -Mass and energy -Quantum model -Pauli exclusion principle	**3**

2.	Radioactivity -Line of stability -Radioactivity decay types -Decay of radioactivity	**6**
3.	Photon attenuation -Absorption of energy -Linear attenuation coefficient -Mass attenuation coefficient -Atomic attenuation coefficient -Mean free path and half-value layer -Factors affecting attenuation -Energy transfer and energy absorption	**9**
4.	Photon interaction -Coherent scattering -Photoelectric effect -Compton scattering -Pair production -Total mass attenuation coefficient	**6**
5.	Electron interaction -Stopping power -Collisional interaction -Radiative interaction	**6**
6.	Particle interaction -Neutrons -Protons -Linear energy transfer -Relative biological effectiveness	**6**
7.	Radiation quality and quantity -Photon fluence -Energy fluence -Exposure -Dose equivalent	**6**
8.	Production of clinical X-ray: X-ray tube	**3**

	Lab topics The student will conduct experiments related to the theoretical topics mentioned above.	**45**
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	**1-Radiation Physics for Medical Physicists 3rd ed Ervin B. Podgoršak Springer 2016 ISBN 978-3-319-25380-0** **2-Introduction to radiological physics and radiation dosimetry Frank Herbert- Wiley 2004, ISBN-13: 978-0-471-01 146-0**
Supportive References	www.iomp.org www.aapm.org www.afomp.org
Electronic Materials	The following journals are recognized as official publications of the IOMP: 1. Physics in Medicine and Biology 2. Physiological Measurement 3. Medical Physics 4. Journal of Applied Clinical Medical Physics 5. Medical Physics International
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms
Technology equipment (projector, smart board, software)	Data show, the Smart Board
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Instructor	Homework & quiz
Effectiveness of Students assessment	Instructor	Questionnaires.
Quality of learning resources	Student	Questionnaires.
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MEDICAL PHYSICS COMMITTEE**
REFERENCE NO.	
DATE	**1-1-2025**

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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

2023
TP-153

Course Specification

(Bachelor)

Course Title:	General Chemistry 1
Course Code:	CHM1101
Program:	Chemistry
Department	Chemistry
College:	Science
Institution	Umm Al-Qura University
Version:	1
Last Revision Date:	Al-27 December 2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2 Theoretical + 1 Experimental)					
2. Course type					
A.	☐University	☒ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (1/1)					
4. Course general Description:					
This course presents the essential principles and common applications of chemistry. It introduces the elementary principles and theories of chemistry, electronic structure of atoms, quantum mechanics and atomic orbitals; representations of orbitals, gases laws and properties, Intermolecular forces, liquids, solids, solutions, kinetics, equilibria, precipitation, thermodynamics, electrochemistry, organic chemistry					
5. Pre-requirements for this course (if any)**:--**					
6. Pre-requirements for this course (if any)**:--**					
7. Course Main Objective(s):					
The course introduces some basic principles of physical, organic and inorganic chemistry.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100 %
2	E-learning	-	
3	Hybrid • Traditional classroom • E-learning	-	
4	Distance learning	-	

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	

5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Explain fundamental concepts and principles of units, measurements, physical, inorganic and organic chemistry.	K1	Lectures Library visits	Exam
2.0	**Skills**			
2.1	Demonstrate the ability to use basic laboratory techniques, tools, to conduct experiments, collect data, and analyze results related to fundamental chemistry topics	S1	Laboratory	Practical Exam Lab Reports Quiz
2.2	Solve quantitative and qualitative problems related to chemical equations, thermochemical processes, and kinetics.	S2	Lectures Web-based study	Quiz. Exam. Class discussion
2.3	Analyze and interpret data related to chemical equilibria and electrochemical reactions.	S3	Lectures Scientific discussion Web-based study	Quiz. Exam. Class discussion
3.0	**Values, autonomy, and responsibility**			
3.1	Ability to demonstrate learning skills to work as a team in a multidisciplinary environment.	V1, V2	Scientific discussion	long and short essays posters lab manuals

C. Course Content

No	List of Topics	Contact Hours
1.	Electronic structure of atoms, quantum mechanics and atomic orbital	4
2.	Gases laws and properties	4
3.	Intermolecular forces, liquids, solids, solutions	4
4.	Chemical kinetics	4
5.	Chemical equilibria	4
6.	Thermodynamics,	4
7.	Electrochemistry,	4
8.	Organic chemistry	2
	List of Experiments	
1.	safety in chemistry laboratory	3
2.	intermolecular forces: viscosity, density, and surface tension	12
3.	atomic structure and quantum mechanics	3
4.	acids and bases titration	9
5.	determination of the heat capacity of the calorimeter	6
6.	solutions	6
7.	chemical equilibrium	6
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
	Class activities, and Assignments	Throughout the Term	10%
	Mid-Term Exam (s)	8	20%
	Lab Activity	Throughout the Term	20%
	Practical Exam	15	10%
5.	Final Exam.(2 hours exam)	End of the Term	40%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Steven S. Zumdahl, Susan A. Zumdahl, 9th ed., 2009, New York.
Supportive References	P. Atkins and J. de Paula, Physical Chemistry, 10th ed., 2006, New York.
Electronic Materials	Power point lectures.
Other Learning Materials	Course available online

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Classrooms, laboratories
Technology equipment (projector, smart board, software)	The classroom is equipped with computer and projector.
Other equipment (depending on the nature of the specialty)	None

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Indirect: course evaluation and graduates survey).
Effectiveness of students' assessment	Department	Improving course quality and effectiveness.
Quality of learning resources	Students	Direct: (feedback from faculty). Indirect (online survey at the end of the semester
The extent to which CLOs have been achieved	Faculty members	Direct:(Comments of course instructors regarding evaluation of teaching strategies for learning outcomes mentioned in course report).
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	

Ministry Of Education وزارة التعليم
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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Fundamentals of Quantum Mechanics
Course Code:	PHYS4908
Program:	Medical Physics
Department:	Physics
College:	Science
Institution :	Umm Al-Qura University
Version:	47
Last Revision Date:	12/1/2025

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 4/2nd year)					
4. Course General Description:					
This course introduces the fundamental principles of quantum mechanics, covering wave functions and Schrödinger equations. Students will explore time-independent Schrödinger equations, including infinite square wells, harmonic oscillators, and finite square well potentials. The course also delves into formalism, including Hilbert space, observables, operators, and Dirac notation. Finally, applications in three dimensions are examined, focusing on spherical coordinates, hydrogen atoms, angular momentum, and spin.					
5. Pre-requirements for this course (if any)**:**					
Introductory Modern Physics PHYS3903					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course aims to equip students with the ability to: - Apply quantum mechanical principles to solve problems - Interpret wave functions, Schrödinger equations, and statistical interpretations - Analyze quantum phenomena, including uncertainty principle and superposition					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
	Describe the concept of wave function (probability, normalization, uncertainty)	K1	Lectures	Exams, homework and quizzes
	Describe hydrogen atom energy levels and understand orbital and spin angular momenta	K1		
2.0	Skills			
2.1	Solve time-independent Schrodinger equation for one-dimension potential and for radial potential (hydrogen)	S1	Lectures	Exams, homework and quizzes
2.2	Apply Dirac notation to represent quantum states, operators, and observable	S2		
3.0	Values			

C. Course Content

No	List of Topics	Contact Hours
1.	**The Wave Function** 1. The Schrödinger equation 2. The Statistical Interpretation 3. Normalization 4. Momentum 5. The Uncertainty Principle	9
2.	**Time-Independent Schrödinger Equation** 1. The Infinite Square Well 2. The Free Particle: Continuous States 3. The Finite Square Well Potential 4. The Harmonic Oscillator	12
3.	**Formalism** 1. Hilbert Space 2. Observables and Operators 3. Eigenfunctions of a Hermitian Operator 4. Generalized Statistical Interpretation, Uncertainty Principle 5. Dirac Notation	12
4.	**Quantum Mechanics in Three Dimensions** 1. Schrödinger Equation in Spherical Coordinates 2. The Hydrogen Atom 3. Angular Momentum 4. Spin 5. Addition of Two Angular Momemta	12
	Total	**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework and Quizzes**	**During the semester**	**20%**
2.	**Midterm Exams**	**5th - 10th week**	**30%**
4.	**Final Exam**	**End of the semester**	**50%**
5.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

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1. References and Learning Resources

Essential References	Griffiths, D. J. and Schroeter, D. F. Introduction to Quantum Mechanics, 3rd Edition (2018), Cambridge University Press, 2004. ISBN: 9781107189638.
Supportive References	1. Zettili, N. Quantum Mechanics: Concepts and Applications, 3rd Edition (2022), John Wiley & Sons Inc. ISBN-13 : 978-1118307892 2. Cohen-Tannoudji, et al. Quantum Mechanics, Vol. 1, 2nd Edition (2020), Wiley, ISBN: 978-3-527-82271-3 3. Cohen-Tannoudji, et al. Quantum Mechanics, Vol. 2, 2nd Edition (2019), Wiley, ISBN: 978-3-527-82273-7
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct /Questionnaire
Effectiveness of Students assessment	Instructor	Direct /Exams
Quality of learning resources	Instructor	indirect /Course report
The extent to which CLOs have been achieved	Instructor	indirect /Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics department council
REFERENCE NO.	Minutes of session No. xx

DATE	x/x/2025

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Course Specification

(Bachelor)

Course Title: Introductory Classical Mechanics	
Course Code: PHYS4909	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 12/1/2025.	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (Level 4/2nd Year)					

4. Course General Description:

This course provides an introduction to fundamental concepts of classical mechanics: Newtonian Mechanics, motion in 1- and 3- dimensions, Noninertial Reference Systems, Gravitation and Central Forces, Dynamics of Systems of Particles.

5. Pre-requirements for this course (if any)**:**

Theoretical Methods in Medical Physics PHYS3904

6. Co-requisites for this course (if any)**:**

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7. Course Main Objective(s):

The objective of this course is to introduce the fundamental physical laws of classical mechanics and apply the fundamental physical laws of motion to a variety of practical problems.
The student will be able to
- Describe the rectilinear motion of a single particle using vector algebra.
- Describe the damped and forced harmonic motion mathematically.
- Describe the equations of motion of a falling body in resisting medium.
- Derive the physical formulas related to the constrained motion of a particle.
- Derive the formulas related to the motion of a particle in a central field.
- Describe the Kepler's laws of planetary motion using mathematics.
- Calculate the energy equation of the orbit and the periodic time of orbital motion.
- Calculate the center of mass, angular momentum, and kinetic energy of a system of particles.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning	--	
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	
5.	**Others (specify)**	-
Total		30

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B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define the physical quantities related to the motion of a single particle.	K1	Lectures	Exams, homework and quizzes
1.2	Define the physical quantities related to the motion of the particle in a rotating system.	K1		
1.3	Describe Kepler's laws of planetary motion using mathematics.	K1		
2.0	**Skills**			
2.1	Apply Newton's laws to solve problems.	S1	Lectures	Exams, homework and quizzes
2.2	Apply appropriate models for solving problems related to the motion of a particle in a central field.	S2		
3.0	**Values, autonomy, and responsibility**			

C. Course Content

No	List of Topics	Contact Hours
1.	**Fundamental Concepts Vectors** ● Revision of vectors ● Triple products ● Derivative of a vector ● Position vector of a particle velocity and acceleration in rectangular coordinates. ● Velocity and acceleration in polar coordinates. ● Velocity and acceleration in cylindrical and spherical coordinates.	6
2.	**Newtonian Mechanics, Rectilinear Motion of a Particle** ● Newton's law of motion. ● Rectilinear Motion: uniform Acceleration under a constant force. ● Position-dependent forces. ● The Concepts of kinetic and potential energy. ● Velocity-dependent forces. ● Fluid resistance and terminal velocity. ● Linear Resorting Force: harmonic motion. ● Energy considerations in harmonic motion. ● Damped harmonic motion. ● Forced harmonic motion: resonance.	6
3.	**General Motion of a Particle in Three Dimensions** ● The potential energy function in three-dimensional motion ● The del operator ● Forces of the separable type. ● The harmonic oscillator in two and three dimensions. ● Constrained motion of a particle. ● Motion of Charged Particles in Electric and Magnetic Fields ● Simple pendulum. ● More accurate solution of the simple pendulum problem.	4
4.	**Noninertial Reference Systems** • Accelerated coordinate systems and inertial forces. • Rotating coordinate systems. • Dynamics of a particle in a rotating coordinate system. • Effects of earth's rotation. • The Foucault pendulum.	4
5.	**Gravitation and Central Forces** • Introduction. • Gravitational force between a uniform sphere and a particle. • Kepler's laws of planetary motion. • Kepler's second law: equal areas.	6

	• Kepler's first law: The law of ellipses. • Kepler's third law: The harmonic law. • Potential energy in a gravitational field: gravitational potential. • Potential energy in a general central field. • Energy equation of an orbit in a central field.	
6.	**Dynamics of Systems of Particles** • Center of mass and linear momentum of a system. • Angular momentum and kinetic energy of a system. • Motion of two interacting bodies: the reduced mass. • Collisions. • Oblique collisions and scattering: comparison of laboratory and center of mass coordinates. • Motion of a body with variable mass: rocket motion.	**4**
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework and Quizzes	During the semester	20%
2.	Midterm Exams	5^{th} - 10^{th} week	30%
3.	Final Exam	End of the semester	50%
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	G.R. Fowles and G. L. Cassiday (2005), Analytical Mechanics, Cengage Learning; 7th edition (March 19, 2004). ISBN-13 : 978-0534494926
Supportive References	John R. Taylor (2005), Classical Mechanics, University Science Books,U.S.; null edition (15 September 2004). ISBN-13 : 978-1891389221. Stephen Thornton and Jerry Marion, Classical Dynamics of Particles and Systems, Cengage Learning; 5th edition (July 7, 2003). ISBN-13 : 978-0534408961
Electronic Materials	--
Other Learning Materials	--

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom
• Blackboard Projector	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	--

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct /Questionnaire
Effectiveness of Students assessment	Instructor	Direct /Exams
Quality of learning resources	Instructor	indirect /Course report
The extent to which CLOs have been achieved	Instructor	indirect /Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics department council
REFERENCE NO.	Minutes of session No. xx
DATE	X/X/2025

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Course Specification

(Bachelor)

Course Title:	Material Science
Course Code:	PHYS4907
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	7/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: 4 (3+1)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (level 4 / year 2)					
4. Course General Description:					
This course contains and describes the basic phenomena and concepts of chemical bonding in solids, crystal structures thermal properties of the lattice, and semiconductors.					
5. Pre-requirements for this course (if any):					
Introductory Modern Physics PHYS3903					
6. Co-requisites for this course (if any):					
7. Course Main Objective(s):					
After completing this course student should be able to deal with the following concepts: 1. Binding in Solid. 2. Crystal Structure. 3. Phonons. 4. Free electron model. 5. Energy bands in solids. 6. semiconconductor.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100 %
2	E-learning		
3	Hybrid		

No	Mode of Instruction	Contact Hours	Percentage
	• Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Definde the atomic binding in the crystals	K1	Lectures	Exams, Homework, Quizzes
1.2	Describe the crystal sturcture	K2		
...				
2.0	**Skills**			
2.1	solve problems related to phonons phenomena	S1	Lectures	Exams, Homework, Quizzes
2.2	solve problems related to semiconductor phenomena	S1		
2.3	Apply concepts of physics to predict the energy bands structure of solids	S2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures	Exams, Homework, Quizzes
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Crystal Structure** • Crystal Lattice and Translation Vectors • Unit Cell • Basis • Symmetry Operations • Point Group and Space Group • Types of Lattices • Lattice Directions and Planes • Interplanar Spacing • Simple Crystal Structures • Close-Packed Structures • Loose-Packed Structures • Structure of Diamond • Zinc Blende (ZnS) Structure • Sodium Chloride (NaCl) Structure	9
2.	**Crystal Binding and Elastic Constants** • Crystal of Inert Gases. • Ionic Crystals. • Covalent Crystals. • Metals. • Hydrogen Bonds. • Atomic Radii. • Analysis of Elastic Strains. • Elastic Compliance and Stiffness Constants. • Elastic Waves in Cubic Crystals.	6
3.	**Phonons : Crystal Vibrations and Thermal Properties** • Vibrations of Crystals with Monatomic Basis. • Two Atoms per Primitive Basis	6

	• Quantization of Elastic Waves. • Phonon Momentum. • Inelastic Scattering by Phonons. • Phonon Heat Capacity • Anharamonic Crystal Interactions. • Thermal Conductivity.	
	Free Electron Fermi Gas • Energy Level in One Dimension • Effect of Temperature on the Fermi Dirac Distribution. • Free Electron Gas in Three Dimensions. • Heat Capacity of the Electron Gas. • Electrical Conductivity and Ohm's Law. • Motion in Magnetic Field • Hall Effect. • Thermal Conductivity of Metals.	9
4.	**Band theory** • Energy spectra in atoms, molecules and solids. • Bloch theorem. • Brillouin zones. • Number of states in the band. • Nearly free electron model	6
8.	**Semiconductors** • Pure or Intrinsic Semiconductors • Impurity of Extrinsic Semiconductors • Drift Velocity, Mobility and Conductivity of Intrinsic Semiconductors • Carrier Concentration and Fermi Level for Intrinsic Semiconductors. • Carrier Concentration and Fermi Level for Extrinsic Semiconductors. • The pn junction.	9
9.	**Practical Part**	45

Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam (or 2 major exams)	8th week (or 5th and 10th)	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	All weeks	10%
5.	Final Exam	End of term	50%
...			100 %

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• An Introduction to Solid States Physics, C. Kittle, 8th Edition, John Wiley & Son Inc (2005). • Solid State Physics, by R. K. Puri & V. K. Babbar 3rd Edition, Ram Nagar, New Delhi: S. Chand, (2008). • Semiconductor Physics And Devices: Basic Principles. Donald A. Neamen, 4th Edition, McGraw-Hill.
Supportive References	• Introduction to condensed matter Physics, Feng Duan & Jin Guojun, (World Scientific, 2005). • The Oxford solid state basics, Steven H. and Simon, Oxford university press 2016
Electronic Materials	Websites on the internet that are relevant to the course topics
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Fundamentals of electronics	
Course Code: PHYS5910	
Program: Medical Physics	
Department: Physics	
College: Sciences	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 7/1/2025	

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A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 5)					
4. Course General Description:					
This course offers the fundamentals knowledge on electronics; it covers an introduction on conduction mechanisms in semiconductors, devices as pn junction (diode) and some applications of diode in electrical circuits. Treats the characteristics, application of Bipolar junction transistors and the Field effect transistors. Presents the Operational amplifiers and its applications.					
5. Pre-requirements for this course (if any)**:**					
Material Science PHYS4907					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

After completing this course student should be able to deal with the following concepts:

1. Semiconductor devices.
2. Diode Applications.
3. Bipolar Transistors.
4. Amplification of weak electrical signals.
5. Field Effect Transistor (FETs).
6. Operational Amplifiers.
7. In addition to these items, the students should gain practical skills through performing some experiments.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning	-	-

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No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid • Traditional classroom • E-learning	-	-
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Defined electronic device.	K1	Lectures and 1.Lab experiments	Exams, Homework, Quizzes and Lab reports
1.2	Describe the electrical mechanism in electronic device.	K2		
…				
2.0	**Skills**			
2.1	Solve the problems using electrical circuit analysis	S1	Lectures and Lab experiments	Exams, Homework, Quizzes and

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Explain the signal treatment in electronic device.	S2		Lab reports
2.3	Analyze the results of experiments	S3		
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures and ● Lab experiments	Exams, Homework, Quizzes and ● Lab reports
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Semiconductor Basics ● Revision of the fundamental concepts of semiconductors electric properties and pn junction structure	5
2.	Diode Applications ● Half- Wave Rectifiers, Full-Wave Rectifiers ● Power Supply Filters and Regulators ● Diode Limiting and Clamping Circuits	5
3.	Specials diodes ● Zener Diodes, Zener diode applications, Varactor Diodes ● Optical Diodes	5
4.	Bipolar Transistors (BjTs) ● Transistor Structure, Basic Transistor Operation ● Transistor Characteristics and parameters ● The Transistor as an Amplifier, the Transistor as a Switch	5
5.	Transistor Bias Circuits ● The DC Operating Point, Voltage-Divider Bias ● Other Bias Methods	5
6.	BjT Amplifiers ● Amplifier Operation, transistor AC Equivalent Circuits ● The Common-Emitter, Collector , Base Amplifier The Differential Amplifier	4
7.	Field Effect Transistor (FETs) ● The JFET, Characteristics , Parameters and Biasing	4

	• MOSFET Characteristics and parameters, FET Amplifiers	
8.	Power Amplifiers • Class A Power Amplifiers • Class B and Class AB Push-Pull Amplifiers • Class C Amplifiers	4
9.	Amplifier Frequency Response • Basic Concepts, Low-Frequency and high-Frequency Amplifier Response , total Amplifier Frequency Response • Frequency Response of Multistage Amplifiers	4
10.	Operational Amplifiers • Introduction to Operational Amplifiers, Op-Amp Input Modes and Parameters • Some Typical op-amp Circuits, Negative Feedback	4
11.	Practical Part: • Students will conduct various experiments in the practical part of the course. Each student will perform the experiment, collect data, extract result, and prepare a written report every week.	45

Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8th week	20%
2.	HomeWorks & Quizzes	All weeks	10%
3.	Lab. Reports	All weeks	10%
4.	Lab. Exam	End of term	10%
5.	Final Exam	End of term	50%
...	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Electronic devices, Ninth Edition, Thomas L. Floyd
Supportive References	• The Art of Electronics, by Paul Horowitz, and Winfield Hill 3rd Edition (2015)
Electronic Materials	Physics is Beautiful | Free, interactive physics lessons Khan Academy Physics | Physics videos The Feynman Lectures on Physics

	[PhET Simulations | Online physics simulations]()
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Laboratory
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	• Laboratory

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

كلية العلوم
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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Nuclear Medicine Physics
Course Code:	PHYM5301
Program:	Medical Physics
Department:	Physics
College:	Sciences
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

Ministry Of Education
Umm Al-Qura University
وزارة التعليم
جامعة أم القرى
كلية العلوم
قسم الفيزياء

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (……….)					
4. Course General Description:					
The course will cover the principle of radioisotopes used in medicine and operation of related equipment, such as formation of radionuclides, non-scintillation detectors, nonimaging scintillation detectors, imaging instrumentation, radioisotopes medical applications, nuclear medicine imaging and quality control. This course will provide a conceptual and experimental background in nuclear medicine physics sufficient to enable students to take courses that are more advanced in related fields.					
5. Pre-requirements for this course (if any)**:**					
PHYM4201 Medical Radiation Physics (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course is designed to demonstrate and consolidate the physical principles of radioisotopes used in medicine and biology and operation of related equipment, lecture include; 1 Basic Nuclear Medicine Physics, 2 Formation of Radionuclides, 3 Nonscintillation Detectors, 4 Nonimaging Scintillation Detectors, 5 Imaging Instrumentation, 6 Radioisotopes medical applications 7 Nuclear medicine imaging 9 Quality Control					

10 Radiation protection in nuclear medicine

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	- Understanding the outlines of the Physics of nuclear medicine.	K1, K2,K3	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist.	Conducting scientific research and follow-up of

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			Learning. Self-learning.	advances in the field. Quarterly tests. By 15-minute multiple choice test on content on completion of each topic with results carrying 20% of the final assessment. Duties and discussions within the lecture Multiple choice knowledge items on the final exam
1.2				
...				
2.0	**Skills**			
2.1	- estimate mathematical and physical formulas to solve problems in the Physics of nuclear medicine and related fields of studies - interpret the data obtained from the QC of instruments	S1,S3	Problem-solving strategy Cooperative learning strategy Strategy group discussions	Practical test Written test Individual and group activities
2.2	- integrate information technology (IT) based solutions into the Physics of nuclear medicine different fields effectively..	S3,S5	Assigning students to solve the exercises in each chapter	Short cognitive tests. Achievement tests

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
...				
3.0	**Values, autonomy, and responsibility**			
3.1	-work in a group to conduct an experiment. -write a short report in specific subject related to the course materials by using advanced information and communication tools - write a report individually or in a team using the library and the internet - appraise the correctness of their solution, interpret their results, and connect it to related areas of physics of NM.	V1,V2	Training students to build good relationships with their counterparts and collaborate with others and develop personal and professional performance through the following strategies: cooperative learning peer education Enhance confidence in the same student and encourage dialogue and discussion.	Students are assessed through: ▪ evaluation of field activities ▪ verbal tests ▪ assessment assignments ▪ style note Request solutions from each group in front of students.
3.2	- justify the essential parts of a problem and formulate a strategy for solving the problem. - evaluate the solution to a problem and apply appropriate techniques to arrive the solution.	V2,V3	- Raise the spirit of cooperation among students.	- The final evaluation of the collective tasks and discusses their students.
...				

C. Course Content

No	List of Topics	Contact Hours
1	Basic of Nuclear Medicine Physics, Fundamental concepts The power of nuclear medicine The role of physics in nuclear medicine Specific activity FDecay of a mixed radionuclide sample Parent-daughter decay	6

2	Radionuclide and Radiopharmaceutical Production A. Reactor-produced radionuclides B. Accelerator-produced radionuclides C. Radionuclide generators D. Equations for radionuclide production E. Radionuclides for nuclear medicine F. Radiopharmaceuticals for clinical applications	3
3	Problems in Radiation Detection and Measurement Scintillation detectors Detection efficiency Problems in the detection and measurement of β particles Dead time Quality assurance for radiation measurement systems	3
4	Pulse-height SPECTrometry A. Basic principles B. SPECTrometry with nai(tl) C. SPECTrometry with other detectors	3
5	Counting systems A. Nai(tl) well counter B. Counting with conventional nai (tl) detectors C. Liquid scintillation counters	3
6	The gamma camera: basic principles A. General concepts of radionuclide imaging B. Basic principles of the gamma camera C. Types of gamma cameras and their clinical uses	3
7	The gamma camera: performance characteristics A. Basic performance characteristics B. Detector limitations: nonuniformity and nonlinearity C. Design and performance characteristics of parallel-hole collimators D. Performance characteristics of converging, diverging, and pinhole collimators E. Measurements of gamma camera performance	3
8	Tomographic Reconstruction in Nuclear Medicine A. General concepts, notation, and terminology B. Backprojection and Fourier-based techniques C. Image quality in Fourier transform and filtered back projection techniques D. Iterative reconstruction algorithms	6

	E. Reconstruction of fan-beam, cone-beam, and pinhole SPECT Data, and 3-d PET data	
9	Single Photon Emission Computed Tomography A. SPECT systems B. Practical implementation of SPECT C. Performance characteristics of SPECT systems D. Applications of SPECT	3
10	Positron Emission Tomography A. Basic principles of PET imaging B. PET detector and scanner designs C. Data acquisition for PET D. Data corrections and quantitative aSPECTs of PET E. Performance characteristics of PET system F. Clinical and research applications of PET	6
11	Hybrid Imaging: SPECT/CT and PET/CT A. Motivation for hybrid systems B. X-ray computed tomography C. SPECT/CT systems D. PET/CT E. Attenuation and scatter correction using CT, radioisotopes F. Hybrid PET/MRI and SPECT/MRI	3
12	Tracer Kinetic Modeling A. Basic concepts B. Tracers and compartments C. Tracer delivery and transport D. Formulation of a compartmental model E. Examples of dynamic imaging and tracer kinetic	3
	Dose Calibrator quality control (QC) Survey Meters quality control Gamma camera quality control Mo 99-Tc99m Generator & Radiopharmaceutical quality control Thyroid uptake calculation Calculation of the doses of radioiodine Left Ventricular Ejection Fraction (EF) Renal glomerular filtration rate (GFR) Well Counter quality control (QC)	45
Total		**90**

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D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Physics in Nuclear Medicine 4th Edition - Simon Cherry, James Sorenson, Michael Phelps eBook ISBN: 9781455733675 Hardcover ISBN: 9781416051985 2-Rachel A. Powsner, Edward R. Powsner "Essential Nuclear Medicine Physics" Blackwell Publishing Ltd 2006
Supportive References	Practical Nuclear Medicine Third Edition Peter F. Sharp Howard G. Springer ISBN: 978-1-85233-875-6
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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Course Specification

(Bachelor)

Course Title:	Physics of Radiation Therapy (1)
Course Code:	PHYM5302
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (……….)					
4. Course General Description:					
This course provides the necessary practical and theoretical background for the support of a radiotherapy physics service within radiotherapy. The course provides the basis for understanding physical principles within radiotherapy, focusing on clinical application. Important topics are: Equipment for generating/delivering ionizing electron- and photon radiation, clinical radiation dosimetry, characteristics and specifications of radiation fields, treatment planning (volume definitions, field setup, fractionations, modern techniques and dose calculation algorithms), quality assurance, and possibilities and limitations related to treatment modalities like brachytherapy and particle therapy.					
5. Pre-requirements for this course (if any)**:**					
PHYM4201 Medical Radiation Physics (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
On completion of this course, students should be able to: - Describe the basic principles underlying radiotherapy methods; - Explain the principles of radiotherapy equipment; - Define the characteristics of clinical beams and their measurement; - Describe dosimetry measurements used in radiotherapy and MU calculations; - Perform basic treatment planning in radiotherapy; - Perform basic QC for equipment in radiotherapy; - Discuss a range of clinical applications					

2. Teaching mode (mark all that apply)

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No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Understand the production of radiotherapy photon beam	**K1, K2**	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam)

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				Long exam (final exam)
1.2	Use correction factors for MU calculations	**K2, K3**	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.3	List different treatment planning techniques	**K3**	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
2.0	**Skills**			
2.1	-Interpret the dose distribution of using different RT delivery techniques	**S1, S2, S3, S4**	-Problem-solving strategy -Cooperative learning strategy -Strategy group discussions -Assigning students to solve the exercises in each chapter	-Written test -Individual and group activities -Short cognitive tests. -Achievement tests
2.2	-Solve problems related to the output calculations	**S1, S2**	-Problem-solving strategy	-Written test
...				

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.0	Values, autonomy, and responsibility			
3.1	- Summarize the different correction factors.	V1, V2, V3, V4	-Flipped classroom -Cooperative learning	-Short quiz in class -Discussion in class
3.2	- Justify the essential parts of different treatment plan techniques.	V1, V2, V3, V4	- Reports about different tasks	- Report Assignment - Class activities assignment - Electronic exams
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Radiation in the Treatment of Cancer** ● Kilovoltage x-ray Units ● Linear Accelerator ● Cobalt Machines ● Simulator	6
2.	**Dose Distribution and Scatter analysis** ● Phantoms ● Depth Dose Distribution ● Percentage Depth Dose ● Tissue-Air Radio ● Scatter-air Ratio	6
3.	**Patient dose Computation Methods** ● Acquisition of patient data ● Treatment simulation Source to axis distance and isocentric techniques	6
4.	**A system of Dosimetric calculations** ● Dose calculation parameters ● Formalism for the calculation of Monitor unit ● SSD set-up vs isocentric set-up	6
5.	**Treatment Planning I:Isodose Distribution** ● Isodose chart ● Measurement of isodose curves.	6

6.	**Treatment Planning: Patient data, Corrections, and set-up, Field Shaping, Skin dose** • parameters of isodose curves • Combination of radiation fields • Wedge field techniques • Tumor dose specification for external photon beams • Field shaping • Skin dose	6
7.	**IMRT and VMAT delivery** • Rationale for IMRT • Delivering IMRT treatment • Other IMRT delivery methods • Inverse Planning	6
8.	**Image-guided radiation therapy**	3
---	**Lab topics** **The student will conduct experiments related to the theoretical topics discussed above.**	45
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	The Physics of Radiation Therapy- Faiz M. Khan, John P. Gibbons 2020 -6th ed by Wolters
Supportive References	Walter and Miller's Textbook of Radiotherapy Radiation Physics, Therapy and Oncology 7th ed Edited by Paul Symonds 2012 Elsevier, ISBN 978 0 443 07486 8
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**-Classroom** **-Library**
Technology equipment (projector, smart board, software)	**Blackboard**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MEDICAL PHYSICS COMMITTEE**
REFERENCE NO.	
DATE	**1-1-2025**

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Course Specification

(Bachelor)

Course Title: Physics of Medical Imaging (1)	
Course Code: PHYM5303	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 30-12-2024	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (……….)					
4. Course General Description:					
This course introduces the main methods of medical imaging, namely X-ray radiography, computed tomography (CT), mammography, and X-ray fluoroscopy. It enables students to develop an understanding of the physics principles underlying these imaging techniques and an awareness of their clinical applications. It also discusses the mathematical principles involved in image formation and processing and provides experience in their use.					
5. Pre-requirements for this course (if any)**:**					
PHYM4201 Medical Radiation Physics (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
At the end of this course, the student should be able to: - Describe the physics principles underlying the operation of medical imaging equipment. - List, in words, merits and drawbacks of each imaging modality. - Demonstrate an understanding of and apply mathematical methods of image construction and processing - Compare the different methods of image processing of different modalities. - Demonstrate an understanding of aspects of clinical applications of imaging modalities; - Interpret the images and state the artifacts of each imaging modality					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	-Understand the basic physical principles of different imaging modalities. -Outline the merits and drawbacks of each imaging modality.	K1, K2	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.2	-Use mathematical formulation to describe the physical	K2,K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	principle of different imaging modes			Discussion in the lecture Short exams (midterm exam) Long exam (final exam
1.3	- List the tools required for each imaging modality	K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam
2.0	Skills			
2.1	- Interpret the physical principle of the imaging modality and its usage in the design of the equipment - Solve problems related to the mathematical principles of the imaging modality - Compare between the properties of different imaging modes and their medical applications - Analyse different artifacts of images of different imaging modalities.	S1,S2,S3,S4	- Problem-solving strategy - Cooperative learning strategy - Strategy group discussions - Assigning students to solve the exercises in each chapter Using the Matlab program to analyze some imaging modalities	- Written test - Individual and group activities - Short cognitive tests. - Achievement tests - Seminar - Electronic exam - Some applications using software
2.2				
...				
3.0	Values, autonomy, and responsibility			
3.1	- Summarize the different modes of imaging. - interpret the artifacts of the images for each imaging modality.	V1,V2,V3	Training students to build good relationships with their counterparts collaborate with others and develop personal and professional	Students are assessed through: - evaluation of field activities - Report - Short quiz in class

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	- justify the essential parts of different clinical situations and formulate a strategy for the optimum setup of each clinical situation.		performance through the following strategies: - cooperative learning flipped classroom	Discussion in class
3.2	- Use software to analyze the images of different modalities - Work independently and in groups to represent a seminar about a topic related to the study. - Use the internet to search for topics and write reports - Know the standards for writing a good report	V1,V2.V3	- Group seminar discussion - Reports about different tasks	- Report Assignment - Class activities assignment - Electronic exams
...				

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to Medical Imaging** 1The Modalities 2 Image Properties 3. Radiation 4. Attenuation of X-rays and Gamma Rays 5. Absorption of Energy from X-rays and Gamma Rays 6. Imparted Energy, Equivalent Dose, and Effective Dose	6
2	**Image Quality** 1 Spatial Resolution 2 Convolution 3 Physical Mechanisms of Blurring 4 The Frequency Domain	6

	5 Contrast Resolution 6 Noise Texture: The Noise Power Spectrum 7 Contrast 8 Contrast-to-Noise Ratio 9 Signal-to-Noise Ratio 10 Contrast-Detail Diagrams 11 Detective Quantum Efficiency 12 Receiver Operating Characteristic Curves	
3	**Medical Imaging Informatics** 1 Analog and Digital Representation of Data 2 Digital Radiological Images 3 Digital Computers 4 Information Storage Devices 5 Display of Digital Images 6 Computer Networks 7 PACS and Teleradiology 8 Image Processing	3
4	**Radiography** 1. X-ray Production, X-ray Tubes, and x-ray Generators 2. Geometry of Projection Radiography 3. Screen-Film Radiography 4. Computed Radiography 5. Radiographic Detectors, Patient Dose, and Exposure Index 6. Dual-Energy Radiography 7. Scattered Radiation in Projection Radiographic Imaging	6
5	**Mammography** 1 x-ray Tube and Beam Filtration 2 x-ray Generator and Phototimer System 3 Compression, Scattered Radiation, and Magnification 4 Screen-Film Cassettes and Film Processing 5 Digital Mammography 6 Radiation Dosimetry 7 Regulatory Requirements	6

6	**Fluoroscopy** 1 Functionality 2 Fluoroscopic Imaging Chain Components 3 Fluoroscopic Detector Systems 4 Automatic Exposure Rate Control 5 Fluoroscopy Modes of Operation 6 Image Quality in Fluoroscopy 7 Fluoroscopy Suites 8 Radiation Dose	6
7	**Computed Tomography** 1 Clinical Use 2 CT System Designs 3 Modes of CT Acquisition 4 CT Reconstruction 5 Image Quality in CT 6 CT Image Artifacts 7 CT Generations	6
8	**X-ray Dosimetry in Projection Imaging and Computed Tomography** 1 Attenuation of X-rays in Tissue 2 Dose-Related Metrics in Radiography and Fluoroscopy 3 Monte Carlo Dose Computation 4 Equivalent Dose 5 Organ Doses from X-ray Procedures 6 Effective Dose 385 7 Absorbed Dose in Radiography and Fluoroscopy 8 CT Dosimetry and Organ Doses 9 Computation of Radiation Risk to the Generic Patient 10 Computation of Patient-Specific Radiation Risk Estimates 11 Diagnostic Reference Levels 12 Increasing Radiation Burden from Medical Imaging	6
	Laboratory 1. X-ray Production and Detection: 2. Attenuation Coefficients Measurement: 3. Radiographic Image Formation: 4. X-ray Diffraction Analysis:	45

	5. Computed Tomography (CT) Imaging: 6. Contrast Media Evaluation: 7. Radiographic Film Characteristics: 8. Digital Radiography Systems: 9. Radiation Dose Measurement: 10. Scatter Radiation Analysis:	
Total		**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework, Quizzes, and scientific activities**	**All weeks**	**10%**
2.	**Midterm Exam**	**6th week**	**20%**
3.	**Lab. Final Exam**	**Term End**	**20%**
4.	**Final Exam**	**Term End**	**50%**
5.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-The Essential Physics of Medical Imaging 3rd ed. JERROLD T. BUSHBERG 2012 by LIPPINCOTT WILLIAMS ISBN 978-0-7817-8057-5 2- William R. Hendee and Russell E. Ritenour "Medical Imaging Physics" 4th Eds. Wiely-Liss. 2002. (Electronic + Hard Copies)
Supportive References	1-Paul Suetens. "Fundamentals of Medical Imaging", 2nd Ed., Cambridge University Press, 2009. 2- Farr's Physics for Medical Imaging 2nd ed. Penelope Allisy- Roberts Elsevier Limited 2008 ISBN: 978-0-7020-2844-1 3-Ultrasonics Fundamentals, Technologies, and Applications 3rd ed. Dale Ensminger 2012 by Taylor & Francis Group, ISBN 13: 978-1-4200-2027-4
Electronic Materials	• http://www.diagnosticimaging.com/ • http://www.who.int/diagnostic_imaging/en/ • https://imagej.nih.gov/ij/ • https://www.iaea.org/newscenter/multimedia/videos/safe-medical-imaging-for-children • https://www.iaea.org/topics/diagnosis-of-diseases • https://www.radiologyinfo.org/en/submenu.cfm?pg=test-treatment
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

Ministry Of Education
Umm Al-Qura University
وزارة التعليم
جامعة أم القرى
كلية العلوم
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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Physics of Radiation Therapy (2)
Course Code:	PHYM6304
Program:	Medical physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	29/12/2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐University	☐College	☐Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 6 /3rd year.)					
4. Course General Description:					
This course provides the necessary practical and theoretical background for the support of a radiotherapy physics service within radiotherapy. The course provides the basis for understanding ionization chamber calibration within radiotherapy. Important topics are: dose verification, quality assurance, and possibilities and limitations related to treatment modalities like brachytherapy and particle therapy.					
5. Pre-requirements for this course (if any):					
Physics of Radiation Therapy (1)					
6. Co-requisites for this course (if any):					
no					
7. Course Main Objective(s):					
On completion of this course, students should be able to: - Describe the basic principles of Cavity ionization chambers - Explain the dose verifcation - Define electron beam and brackytherapy - Describe dose verifcation - Perform basic ionization chambers corrections for reading -					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	100%
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outlines about type of **ionization chambers corrections for reading**	**K3,K2**	Start each chapter by general idea of the meaning of correction Demonstrate the principles through lectures. Describing calculation concepts with solving problems	1.Home work 2.discussion 3.Short exam1 4.Short exam2 Final exam

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2	- List electron beam and brackytherapy			1. Oral questions 2. Presentations 3 .Quizzes 4. Problem solving
…				
2.0	**Skills**			
2.1	**Dose verification procedure**	**S1,S2**	Lectures	Exam must contain questions that can measure these skills.
2.2	Quality assurance		Brain storming	Quiz and exams Discussions after the lecture
…	Enhancing the ability of students to use computers and internet.		Discussion	Quiz and exams Discussions after the lecture
3.0	**Values, autonomy, and responsibility**			
3.1	Appraise the cooperation through teamwork to make a decision.	V1	Discussion	**collabrative presentation**
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1.	**Dosimetry in Radiotherapy** • **Cavity ionization chambers** ❖ **ionization chambers corrections for reading** ❖ **Absorbed dose to water based codes (TG-51 & TRS-398)**	**9**

2.		
---	Electron beam Therapy. • Electron interactions • Determination of absorbed dose • Characteristics of clinical electron beams Field shaping	6
	Patient treatment verification • Position verification Dose verification (pretreatment, in vivo verification)	6
	Quality Assurance Acceptance Tests and Commissioning Measurements Daily, Monty, annually tests ❖	6
	Radiation Protection and Safety in Radiotherapy Safety in the design of facilities	6
	Brachytherapy. The Early History of Brachytherapy Physics Brachytherapy Radionuclides and Their Properties Artificially Produced Radionuclides Production and Construction of Sealed Sources HIGH-DOSE-RATE UNIT HIGH-DOSE-RATE APPLICATORS	6
	Assessment activity	6
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	presentation	14,15	10%
2.	exam	Week7	
3.			
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-The Physics of Radiation Therapy- Faiz M. Khan, John P. Gibbons 2020 -6th ed by Wolters 2-The Physics of Modern Brachytherapy for Oncology D Baltas 2007 by 3- IAEA publication (ISBN 92-0-107304-6): Review of Radiation Oncology Physics: A Handbook for Teachers and Students
Supportive References	
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Class room/lab**
Technology equipment (projector, smart board, software)	**project**
Other equipment (depending on the nature of the specialty)	**-**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Instructor	Questionnaires.
Effectiveness of Students assessment	Instructor	Homework & quiz
Quality of learning resources	**student**	Questionnaires.
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	

Ministry Of Education وزارة التعليم
Umm Al-Qura University جامعة أم القرى
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REFERENCE NO.	
DATE	

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title	Radiation protection and dosimetry
Course Code:	PHYM8203
Program:	Medical physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	29/12/2024

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3)

2. Course type

A.	☐University	☐College	☐Department	☐Track	☐Others
B.	☒ Required		☐Elective		

3. Level/year at which this course is offered: (Level 6 /3rd year.)

4. Course General Description:

This course is interested in studying the The radiation protection roles and Quantities Learn the basic concpt about external and internal radiation protection. In addition, the concept of dosimetry . learn about protection in medical application

5. Pre-requirements for this course (if any)**:**

PHYM5301

6. Co-requisites for this course (if any)**:**

no

7. Course Main Objective(s):

On completion of this course, students should be able to:
the end of this course, the student should be able to
-state the radiation protection prinicibl
- Provide the basic understanding of Alara.
-Explain the instruments for radiation protection
-Calculate the shield

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		

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No	Mode of Instruction	Contact Hours	Percentage
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	100%
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Outlines about radiation protection prinicible	**K3,K2**	Start each chapter by Demonstrate the course information and principles through lectures. Describing radiation Protection roles with solving problems	1.Home work 2.discussion 3.Short exam1 4.Short exam2 Final exam
1.2	List the type dosimter			1. Oral questions 2. Presentations 3 .Quizzes

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				4. Problem solving
...				
2.0	**Skills**			
2.1	Explain the procedure External protection and Alra	**S1,S2**	Lectures	Exam must contain questions that can measure these skills.
2.2	Make a certain decision fast, FOR shield		Brain storming	Quiz and exams Discussions after the lecture
...	Enhancing the ability of students to use computers and internet.		Discussion	Quiz and exams Discussions after the lecture
3.0	**Values, autonomy, and responsibility**			
3.1	Appraise the cooperation through teamwork to make a decision.	V1	Discussion	**collabrative presentation**
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**The system of radiological protection** **1. The role of the International Commission on Radiological Protection (ICRP) , IAEA)** . **2.The recommendations of the International Commission on Radiological Protection** **3.Radiation Dosimetry Units**	**Week 1,2**

	3. Recommended dose limits 4. Planned exposure situations 5. Emergency exposure situations 6. Existing exposure situations	
2.	Radiation Protection and Dose Limits: - Occupational exposure. - Public exposure. - Medical exposure	**Week 3,4**
---	the external radiation protection and Shielding 1.⍰ ALARA principle Time Distance Shielding Photon Shielding ⍰ X-ray Shielding ⍰ Beta Particle Shielding ⍰ Shield Design and Beta-Ray Properties ⍰ Neutron Shielding ⍰ Example: X-ray Shielding for radiographic and cardiac rooms - ALARA principle and practical applications in Saudi facilities and their implementation by SFDA(Saudi food and Drug Authority	**Week 5,6,7**
	Internal radiation protection Sealed & unsealed Sources Type of contamination Internal Contamination Gamma vs Beta Contamination Internal Contamination Routes Assessment of Internal Hazard Reference Man/Woman Annual Limit on Intake Contamination Limits Radiation Protection Measure	**Week 8,9**
	Dosimtery	**Week 10,11,12**

	-thermal,chemical,electrical -Electrical Gas field detector Scintillation detector Semiconductor -Alph and gamma spectroscopy -Calibration consideration Phton Beta Alpha neutron -dsomiter classify to Personal monitoring Survey monitoring	
	5. Radiation protection in diagnostics 6 Radiation protection in Radiotherapy 8 Radiation protection in Nuclear medicine	Week 13,14,15
Total		

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	presentation	14,15	10%
2.	exam	Week7	
3.			
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

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1. References and Learning Resources

Essential References	Herman Cember and Thomas E. Johnson "Introduction to Health Physics" 4th

	-Radiation Protection in Medical Radiography, 7th -Introduction to Health Physics: Fourth Edition 4th Edition
Supportive References	
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Class room/lab**
Technology equipment (projector, smart board, software)	**project**
Other equipment (depending on the nature of the specialty)	**-**

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Instructor	Questionnaires.
Effectiveness of Students assessment	Instructor	Homework & quiz
Quality of learning resources	**student**	Questionnaires.
The extent to which CLOs have been achieved		
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	Ministry Of Education Umm Al-Qura University وزارة التعليم جامعة أم القرى كلية العلوم قسم الفيزياء
DATE	

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Quality Controls in Medical Physics	
Course Code: PHYM6305	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 30-12-2024	

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2+1					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 6)					
4. Course General Description:					
The course "Quality Controls in Medical Physics" provides an in-depth understanding of the principles and practices essential for ensuring accuracy, safety, and effectiveness in medical physics applications. It covers the theoretical and practical aspects of quality assurance (QA) and quality control (QC) procedures in diagnostic radiology, nuclear medicine, and radiotherapy. Students will explore topics such as equipment calibration, performance testing, regulatory compliance, and risk management. The course emphasizes the importance of maintaining high standards in imaging and therapeutic devices to safeguard patient care and optimize clinical outcomes. Through a combination of lectures, hands-on laboratory sessions, and case studies, students will develop the skills needed to design, implement, and evaluate QC programs, ensuring adherence to international standards and guidelines in the field of medical physics.					
5. Pre-requirements for this course (if any)**:**					
PHYM5303 Physics of Medical Imaging (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The main objective of the "Quality Controls in Medical Physics" course is to equip students with the knowledge and skills necessary to implement and maintain effective quality assurance (QA) and quality control (QC) programs in medical physics. This includes ensuring the safety, accuracy, and reliability of diagnostic and therapeutic equipment used in radiology, nuclear medicine, and radiotherapy. The course aims to foster a comprehensive understanding of international standards, regulatory requirements, and best practices, enabling students to identify and address potential risks, optimize equipment performance, and contribute to improved patient outcomes in clinical settings.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	90	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Understand the basic physical principles of different imaging modalities. -Outline the merits and drawbacks of each imaging modality.	K1, K2	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.2	-Use mathematical formulation to describe the physical principle of different imaging modes	K2,K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				Short exams (midterm exam) Long exam (final exam
1.3	- List the tools required for each imaging modality	K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam
2.0	Skills			
2.1	- Interpret the physical principle of the imaging modality and its usage in the design of the equipment - Solve problems related to the mathematical principles of the imaging modality - Compare between the properties of different imaging modes and their medical applications - Analyse different artifacts of images of different imaging modalities.	S1,S2,S3,S4	- Problem-solving strategy - Cooperative learning strategy - Strategy group discussions - Assigning students to solve the exercises in each chapter Using the Matlab program to analyze some imaging modalities	- Written test - Individual and group activities - Short cognitive tests. - Achievement tests - Seminar - Electronic exam - Some applications using software
2.2				
...				
3.0	Values, autonomy, and responsibility			
3.1	- Summarize the different modes of imaging. - interpret the artifacts of the images for each imaging modality. - justify the essential parts of different clinical situations and formulate a strategy for the optimum setup	V1,V2,V3	Training students to build good relationships with their counterparts collaborate with others and develop personal and professional performance through the following strategies:	Students are assessed through: - evaluation of field activities - Report - Short quiz in class Discussion in class

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Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	of each clinical situation.		- cooperative learning flipped classroom	
3.2	- Use software to analyze the images of different modalities - Work independently and in groups to represent a seminar about a topic related to the study. - Use the internet to search for topics and write reports - Know the standards for writing a good report	**V1,V2.V3**	- Group seminar discussion - Reports about different tasks	- Report Assignment - Class activities assignment - Electronic exams
...				

C. Course Content

No	List of Topics	Contact Hours
1	1 Introduction to Quality Management	2
2	2 Quality Improvement Tools and Procedures	2
3	3 Image Quality	2
4	4 FilmScreen Image Receptor Systems	2
5	5 Quality Control of Xray Generators and Ancillary Radiographic Equipment	2
6	6 Radiographic Image Artifacts	2
7	7 Quality Control of Fluoroscopic Equipment	2
8	8 Digital Radiographic and Fluoroscopic Systems and Advanced Imaging Equipment	2
9	9 mammographic quality standards	2
10	10 Quality Control in Computed Tomography	2
11	11 Quality Control for Magnetic Resonance Imaging Equipment	2
12	12 Ultrasound Equipment Quality Assurance	2
13	13 Quality Assurance in Nuclear Medicine	2
14	14 Quality Assurance in Radiotherapy	2
15	Agencies Organizations and Committees in Quality Assurance	2
	Laboratory 1) **X-ray Tube Output Consistency:** *Objective:* Verify consistent radiation output from the X-ray tube. *Procedure:* Measure the output using a calibrated dosimeter at standardized settings to ensure stability over time.	45

2) **Beam Alignment and Collimation Check:**
Objective: Ensure the X-ray beam is properly aligned with the image receptor.
Procedure: Use a collimator test tool to verify that the light field matches the radiation field.
3) **Automatic Exposure Control (AEC) Performance:**
Objective: Assess the AEC system's ability to terminate exposures accurately.
Procedure: Expose a phantom under AEC and measure the resulting image density or dose to confirm proper function.
4) **Image Uniformity and Artifact Evaluation in CT Scanners:**
Objective: Detect non-uniformities or artifacts in CT images.
Procedure: Scan a uniform phantom and analyze the image for any inconsistencies or artifacts.
5) **Spatial Resolution Assessment in MRI Systems:**
Objective: Evaluate the system's ability to distinguish small structures.
Procedure: Use a resolution phantom to acquire images and determine the smallest resolvable detail.
6) **Geometric Accuracy Verification in Radiotherapy Linear Accelerators:**
Objective: Ensure accurate beam targeting for patient treatments.
Procedure: Perform mechanical checks of gantry, collimator, and couch movements to confirm precision.
7) **Dosimetric Output Calibration in Radiotherapy Equipment:**
Objective: Confirm the accuracy of the delivered radiation dose.
Procedure: Use ionization chambers to measure output and compare with prescribed dose values.
8) **Ultrasound Transducer Integrity Testing:**
Objective: Detect defects in ultrasound transducers that could affect image quality.
Procedure: Perform a visual inspection and use a tissue-mimicking phantom to assess image uniformity.
9) **Mammography System Contrast and Resolution Evaluation:**
Objective: Assess the system's ability to visualize low-contrast objects.
Procedure: Use a mammography phantom containing objects of varying contrast and size to evaluate image quality.
10) **Fluoroscopy Dose Rate Measurement:**
Objective: Ensure patient dose rates are within acceptable limits during fluoroscopic procedures.
Procedure: Measure entrance dose rates using a dosimeter under typical operating conditions.
11) **Digital Detector Performance in Radiography:**
Objective: Evaluate the efficiency and response of digital detectors.
Procedure: Assess parameters like detective quantum efficiency (DQE) and modulation transfer function (MTF).
12) **Laser Alignment in Radiotherapy Simulators:**
Objective: Verify that laser positioning systems accurately represent treatment isocenter.
Procedure: Check laser alignment with mechanical isocenter using a dedicated phantom.

	13) **Gantry Tilt Accuracy in CT Scanners:** *Objective:* Ensure the gantry tilt mechanism functions correctly. *Procedure:* Measure the actual tilt angle and compare it with the displayed value. 14) **Radiation Leakage Testing in Radiotherapy Rooms:** *Objective:* Detect any unintended radiation escaping from treatment rooms. *Procedure:* Use survey meters to measure radiation levels around the room perimeter during operation. 15) **Emergency Stop Functionality in Radiotherapy Equipment:** *Objective:* Confirm that emergency stop mechanisms halt equipment operation immediately. *Procedure:* Activate emergency stops during test runs and verify the cessation of all movements and radiation output.	
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6^{th} week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-The Essential Physics of Medical Imaging 3rd ed. JERROLD T. BUSHBERG 2012 by LIPPINCOTT WILLIAMS ISBN 978-0-7817-8057-5 2- Quality Management in the Imaging Sciences E-Book: Quality Management in the Imaging Sciences Jeffrey Papp Elsevier Health Sciences, Sep 11, 2018
Supportive References	1- Handbook of Basic Quality Control Tests for Diagnostic Radiology. International Atomic Energy Agency VIENNA, 2023 2- Farr's Physics for Medical Imaging 2^{nd} ed. Penelope Allisy-Roberts Elsevier Limited 2008 ISBN: 978-0-7020-2844-1 3-Ultrasonics Fundamentals, Technologies, and Applications 3rd ed. Dale Ensminger 2012 by Taylor & Francis Group, ISBN 13: 978-1-4200-2027-4
Electronic Materials	[AAPM Publications - AAPM Reports]

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	*Medical physics Committee*
REFERENCE NO.	
DATE	1/1/2025

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Course Specification
(Bachelor)

Course Title:	Physics of Medical Imaging (2)
Course Code:	PHYM6306
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

Ministry Of Education
Umm Al-Qura University
وزارة التعليم
جامعة أم القرى
كلية العلوم
قسم الفيزياء

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (L6/Y3.)					
4. Course General Description:					
This course introduces the main methods of medical imaging, magnetic resonance imaging (MRI), positron emission tomography (PET), and single photon emission computed tomography (SPECT). It enables students to develop an understanding of the physics principles underlying these imaging techniques and an awareness of their clinical applications. It also discusses the mathematical principles involved in image formation and processing and provides experience in their use.					
5. Pre-requirements for this course (if any)**:**					
PHYM5303 Physics of Medical Imaging (1)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
At the end of this course, the student should be able to: - Describe the physics principles underlying the operation of medical imaging equipment. - List, in words, merits and drawbacks of each imaging modality. - Demonstrate an understanding of and apply mathematical methods of image construction and processing - Compare the different methods of image processing of different modalities. - Demonstrate an understanding of aspects of clinical applications of imaging modalities; - Interpret the images and state the artifacts of each imaging modality					

2. Teaching mode (mark all that apply)

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No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	75	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Understand the basic physical principles of different imaging modalities. -Outline the merits and drawbacks of each imaging modality.	K1, K2	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.2	-Use mathematical formulation to describe the physical	K2,K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	principle of different imaging modes			Discussion in the lecture Short exams (midterm exam) Long exam (final exam
1.3	- List the tools required for each imaging modality	K3	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam
2.0	Skills			
2.1	- Interpret the physical principle of the imaging modality and its usage in the design of the equipment - Solve problems related to the mathematical principles of the imaging modality - Compare between the properties of different imaging modes and their medical applications - Analyse different artifacts of images of different imaging modalities.	S1,S2,S3,S4	- Problem-solving strategy - Cooperative learning strategy - Strategy group discussions - Assigning students to solve the exercises in each chapter Using the Matlab program to analyze some imaging modalities	- Written test - Individual and group activities - Short cognitive tests. - Achievement tests - Seminar - Electronic exam - Some applications using software
2.2				
...				
3.0	Values, autonomy, and responsibility			
3.1	- Summarize the different modes of imaging. - interpret the artifacts of the images for each imaging modality.	V1,V2,V3	Training students to build good relationships with their counterparts collaborate with others and develop personal and professional	Students are assessed through: - evaluation of field activities - Report - Short quiz in class

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	- justify the essential parts of different clinical situations and formulate a strategy for the optimum setup of each clinical situation.		performance through the following strategies: - cooperative learning flipped classroom	Discussion in class
3.2	- Use software to analyze the images of different modalities - Work independently and in groups to represent a seminar about a topic related to the study. - Use the internet to search for topics and write reports - Know the standards for writing a good report	**V1,V2.V3**	- Group seminar discussion - Reports about different tasks	- Report Assignment - Class activities assignment - Electronic exams
...				

C. Course Content

No	List of Topics	Contact Hours
1	**Magnetic Resonance Basics:** 1 Magnetism, Magnetic Fields, and Magnets 2 The Magnetic Resonance Signal 3 Magnetization Properties of Tissues 4 Basic Acquisition Parameters 5 Basic Pulse Sequences 6 MR Signal Localization 7 “K-Space” Data Acquisition and Image Reconstruction	4
2	**Magnetic Resonance Imaging: Advanced Image Acquisition** **Bioeffects, and Safety** 1 Image Acquisition Time 2 MR Image Characteristics	4

	3 Signal from Flow 3 Perfusion and Diffusion Contrast Imaging 4 Magnetization Transfer Contrast 5 MR Artifacts 6 Magnetic Resonance Spectroscopy 7 Ancillary Components 8 MR Bioeffects and Safety	
3	**Ultrasonics:** 1 Introduction 2 Brief Early History 3 Underwater Sound (SONAR) 4 Medical and Biological Ultrasonics 5 Industrial Ultrasonics 6 Nondestructive Testing/Evaluation 7 Ultrasonics in Electronics 8 Physical Acoustics 9 Ultrasonic Systems: Transmitters and Receivers 10 Low-Intensity Applications 11 High-Intensity Applications	4
4	**Basic of Ultrasonic Transducers** 1 Introduction 2 Equivalent Circuits 3 Piezoelectric Transducers 4 Magnetostrictive Transducers 5 Electromagnetic Devices 6 Pneumatic Devices.	4
5	**Ultrasound in Medical Diagnosis** 1 Introduction 2 Power Measurements and Dosages 3 Effect on Human Blood 4 Effect on Tissue Regeneration 5 Equipment	4

	6 Ultrasonic Contrast Agents 7 Diagnosis by Reflection Methods 8 Diagnosis by Doppler Methods	
6	**Ultrasound in Medical Therapy** 1 Equipment 2 Physical Therapy 3 Rheumatic and Related Disorders 4 Sonicated Drug Delivery 5 Phonophoresis 6 Diffusion of Subcutaneous Injections 7 Ophthalmic Therapy 8 Effects on Paced Hearts	4
7	**Nuclear Imaging** 1-The Scintillation Camera 2- Planar Nuclear Imaging: The Anger Scintillation Camera 675 3- Computers in Nuclear Imaging	2
8	**Nuclear Imaging Emission Tomography** 1 Focal Plane Tomography in Nuclear Medicine 2 Single Photon Emission Computed Tomography	2
9	**PET Scanning Systems** Background Solid Scintillation Detectors in PET Arrangement of Detectors PET Scanners Hybrid Scintillation Cameras PET/CT Scanners	2
	Laboratory 1. Basic Ultrasound Imaging Principles: 2. Doppler Ultrasound and Blood Flow Measurement: 3. Ultrasound Beamforming Techniques: 4. Tissue Characterization with Ultrasound:	45

	5. Contrast-Enhanced Ultrasound Imaging: 6. High-Frequency Ultrasound Imaging: 7. Magnetic Resonance Signal Generation and Detection: 8. Spin Echo and Inversion Recovery Pulse Sequences: 9. MRI Spatial Encoding and Image Reconstruction: 10. Magnetic Resonance Spectroscopy (MRS): 11. Contrast Agent in MRI:	
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-The Essential Physics of Medical Imaging 3rd ed. JERROLD T. BUSHBERG 2012 by LIPPINCOTT WILLIAMS ISBN 978-0-7817-8057-5 2- William R. Hendee and Russell E. Ritenour "Medical Imaging Physics" 4th Eds. Wiely-Liss. 2002. (Electronic + Hard Copies)
Supportive References	1-Paul Suetens. "Fundamentals of Medical Imaging", 2nd Ed., Cambridge University Press, 2009. 2- Farr's Physics for Medical Imaging 2nd ed. Penelope Allisy- Roberts Elsevier Limited 2008 ISBN: 978-0-7020-2844-1 3-Ultrasonics Fundamentals, Technologies, and Applications 3rd ed. Dale Ensminger 2012 by Taylor & Francis Group, ISBN 13: 978-1-4200-2027-4
Electronic Materials	• http://www.diagnosticimaging.com/ • http://www.who.int/diagnostic_imaging/en/ • https://imagej.nih.gov/ij/ • https://www.iaea.org/newscenter/multimedia/videos/safe-medical-imaging-for-children • https://www.iaea.org/topics/diagnosis-of-diseases • https://www.radiologyinfo.org/en/submenu.cfm?pg=test-treatment

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	Medical Radiation Physics (2)
Course Code:	PHYM6202
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	18-01-2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4)					
3+1					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (……….)					
4. Course General Description:					
This course provides the necessary practical and theoretical background for the support of understanding the dosimetry fundamentals in medical physics. Starting the course with explanation in depth about dosimetric quantities. Understanding the important of radiation dosimetry in the first place in a simple dosimeter model for photon and charged particles, including different important requirements should be exist in the radiation dosimeter. In addition, the course covers different dosimetric instruments and required calibration procedures.					
5. Pre-requirements for this course (if any)**:**					
PHYM4201 Medical Radiation Physics (1)					
6. Co-requisites for this course (if any)**:**					
Medical Radiation Physics (2) lab.					

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7. Course Main Objective(s):

On completion of this course, students should be able to:

- Describe the basic principles of dosimetric quantities.
- Explain the simple model of dosimetry in term of cavity theories dosimetry for photon and charge particles.
- Understand different important requirements should be exist in the radiation dosimeter including precession, accuracy, stability and more.
- Describe different dosimetric instruments and required calibration procedures.

-

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	45
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		90

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	- Understand the crucial rule for dosimetry application in medical physics field.	**K1, K2**	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam)

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
				Long exam (final exam)
1.2	- Describe different dosmetric quantities	**K2, K3**	Dialogue and discussion. Constructivist. Self-learning.	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
1.3	- Use a simple model of dosimetry to understand dosimetry cavity theories and its assumptions and limitations. - Understand different dosimetry instruments and its required calibration and required factor corrections	**K3**	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)	Quizzes Electronic exams Homeworks Discussion in the lecture Short exams (midterm exam) Long exam (final exam)
2.0	**Skills**			
2.1	- Ability to understand dosmtric quantities. -Interpret the simple mode of dosimetry and related dosimetry cavity theories.	**S1, S2, S3, S4**	-Problem-solving strategy -Cooperative learning strategy -Strategy group discussions -Assigning students to solve the exercises in each chapter	-Written test -Individual and group activities -Short cognitive tests. -Achievement tests
2.2	- Ability to describe different dosimetry instruments,	**S1, S2**	-Problem-solving strategy	-Written test

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	additionally, related requirements, correction factors and calibration.			
...				
3.0	**Values, autonomy, and responsibility**			
3.1	- Explain a simple model of dosimetry to relate that to dosimetry cavity theories for photon and charge particles.	**V1, V2, V3, V4**	-Flipped classroom -Cooperative learning	-Short quiz in class -Discussion in class
3.2	- Compare between different dosimetry instruments, related requirements. Calibrations, correction factors	**V1, V2, V3, V4**	- Reports about different tasks	- Report Assignment - Class activities assignment - Electronic exams
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction of dosimetric quantities.** ● Introduction ● Radiation Field Quantities ● Dosimtric Quantities ● Interaction Coefficients ● Relation between radiation field and dosimetric quantities ● Cavity theories	**6**
2.	**Dosimetry Fundamentals** ● Introduction. ● What is Radiation Dosimetry.	**6**

	• Simple Dosimeter Model in Term of General Guidelines on the Interpretation of Cavity theory Dosimeter Measurements. ○ For Photons and Neutrons. ○ For Charge Particles. - Absoluteness. - Precision and Accuracy. - Dose Range/ Dose Rate Range/ Lower and Upper limits. - Stability. - Energy Dependance. - Miscellany.	
3.	**Ionization Chamber** • Introduction. Free-Air Ion Chambers. • Cavity Ionization Chambers. • Charge and Current Measurements. Ion-Chamber Saturation and Ionic Recombination VI. Ionization, Excitation and W.	6
4.	**Dosimetry and Calibration for Photon and Electron Beams with Cavity Ion Chambers** • Introduction. • Absolute Cavity Ion Chambers. • Calibration of Ion Chambers Using X-Rays or Gamma-Rays. • Calibration of Photon Beams with an Exposure-Calibrated Ion Chamber. • Calibration of Photon Beams of Photon Beams in Phantoms by the NBBI Method • Calibration of Electron Beams in Phantoms.	6
5.	**Integration Dosimeters** • Thermoluminescence Dosimetry. • Photographic Dosimetry. • Chemical Dosimetry. • Calorimetric Dosimtry.	6
6.	**Dosimetry by Pulsed-Mode Detectors** • Introduction. • Geiger-Muller and Proportional Counters. • Scintillation Dosimetry. • Semiconductor detectors for Dosimetry.	6
7.	**Neutron Interactions and Dosimetry**	6

	• Introduction. • Neutron Kinetic Energy. • Neutron Interaction in Tissue. • Neutron Sources. • Neutron Quality Factor.	
8.	**Calculation of Absorbed Dose in Cylindrical Phantom Representing the Human Body**	**3**
---	**Lab topics** **The student will conduct experiments related to the theoretical topics discussed above.**	**45**
	Total	**90**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework, Quizzes, and scientific activities**	**All weeks**	**10%**
2.	**Midterm Exam**	**6th week**	**20%**
3.	**Lab. Final Exam**	**Term End**	**20%**
4.	**Final Exam**	**Term End**	**50%**
5.	**Total**		**100%**
...			

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Radiation Physics for Medical Physicists 3rd ed Ervin B. Podgoršak Springer 2016 ISBN 978-3-319-25380-0 2-Introduction to radiological physics and radiation dosimetry Frank Herbert-Wiley 2004, ISBN-13: 978-0-471-01 146-0
Supportive References	3- Compendium to Radiation Physics for Medical Physicists: 300 Problems and Solutions Ervin B. Podgoršak Springer 2014 ISBN 978-3-319-25380-0
Electronic Materials	www.iomp.org www.aapm.org www.afomp.org/
Other Learning Materials	The following journals are recognized as official publications of the IOMP: 1. Physics in Medicine and Biology

	2. Physiological Measurement 3. Medical Physics 4. Journal of Applied Clinical Medical Physics 5. Medical Physics International

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**-Classroom** **-Library**
Technology equipment (projector, smart board, software)	**Blackboard**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MEDICAL PHYSICS COMMITTEE**
REFERENCE NO.	
DATE	**18-1-2025**

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Field Experience Specification
(Bachelor)

Course Title:	Co-op Training in Physics
Course Code:	PHYM7700
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Field Experience Version Number:	47
Last Revision Date:	13/1/2025

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A. Field Experience Details:

1. Credit hours: (6).

2. Level/year at which Field Experience is offered: (7).

3. Time allocated for Field Experience activities

(15) Weeks	(75) Days	(30) Hours

4. Corequisite (or prerequisites, if any) to join Field Experience

5. Mode of delivery

☐ In-person/onsite	☒ hybrid (onsite/online)	☐Online

B. Field Experience Course Learning Outcomes (CLOs), Training Activities and Assessment Methods

Code	Learning Outcomes	Aligned PLO Code	Training Activities	Assessment Methods	Assessment Responsibility
1.0	Knowledge and understanding				
1.1	List the stages of the field training	K1	Training in the field	•Progress report, •Final presentation	Advisors: 1-faculty member 2- Field member
1.2	Describe each stage using mathematics	K2			
…					
2.0	Skills				
2.1	Apply Physics law in medical physics	S1	Training in the field	•Final report,	Advisors: 1-faculty member 2- Field member
2.2	Explain the scientific procedures in medical physics	S2			
…					
3.0	Values, autonomy, and responsibility				
3.1	Apply standards of integrity and ethics in all tasks	V1	Training in the field	•Progress report,	Advisors: 1-faculty member 2- Field member

Code	Learning Outcomes	Aligned PLO Code	Training Activities	Assessment Methods	Assessment Responsibility
3.2	Collaborate and contribute responsibly and effectively in teamwork	V1		• Final presentation	
...					

*Assessment methods (i.e., practical test, field report, oral test, presentation, group project, essay, etc.).

C. Field Experience Administration

1. Field Experience Flowchart for Responsibility

Including units, departments, and committees responsible for field experience identifying by the interrelations.

1. The Field Experience Committee prepares an integrated plan on field experience based on questionnaires for faculty, students and other institutions, and submits it to the department head.
2. The head of the department displays the topics of field experience and its Institute for students to choose what suits them best.
3. The students apply to choose one of the displayed field experiences.
4. The supervisor (a faculty staff member) should provide the student with guidelines about what kinds of tasks the student is supposed to practice at the field location.
5. The Field Placement Agreements serve as a contract between the University and training organization. These agreements are negotiated annually and must be approved by the Dean of the Applied Science and each organization Superintendent.
6. The students work for 16 weeks (1 day a week, and 5 hours a day) during normal semester, and 8 weeks (2 days a week, and 5 hours a day) during summer semester in the experience field location.
7. The field supervisor, is responsible for guiding and assigning tasks to the student as well as reporting the student's progress to the supervisor in the Physics department, and both are responsible for 60% of the Total Assessment Score given in table 3-a (items 1-6).
8. Finally, the student should give a final report and a presentation about his progress in front of the Field Experience Committee (60% of the Total Assessment Score given in table 3-a (items 7-8).

2. Distribution of Responsibilities for Field Experience Activities

Activities	Department or College	Teaching Staff	Student	Training Organization	Field Supervisor
Selection of a field experience site	✓				
Selection of supervisory staff	✓				
Provision of the required equipment				✓	✓
Provision of learning resources				✓	
Ensuring the safety of the site	✓	✓	✓	✓	✓
Commuting to and from the field experience site			✓		
Provision of support and guidance		✓			✓
Implementation of training activities (duties, reports, projects ...)		✓			✓
Follow up on student training activities		✓		✓	✓
Monitoring attendance and leave		✓		✓	✓
Assessment of learning outcomes		✓			✓
Evaluating the Quality of Field Experience		✓			✓
Others (specify)					

3. Field Experience Location Requirements

Suggested Field Experience Locations	General Requirements*	Special Requirements**
Saudi Standards and Metrology Organization in Jeddah	Agreement of the Department council	Acceptance from Field experience locations.
King Abdulaziz University – Nanotechnology center		
Modern Technology Laboratories Corporation Laboratory		
Saudi Aramco		
The Central Laboratory of the Faculty of Science at any university		
The Central Laboratory of the Faculty of Science at UQU		
Water desalination company		
Saudi Electricity Company		
Factories or companies related to the field.		

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Suggested Field Experience Locations	General Requirements*	Special Requirements**
Radiation centers		
Research Lab within the department		
Hospitals		

* E.g., Provides information technology, equipment, laboratories, halls, housing, learning sources, clinics … etc.
** E.g., Criteria of the institution offering the training or those related to the specialization, such as safety standards, dealing with patients in medical specialties … etc.

4. Decision-Making Procedures for Identifying Appropriate Locations for Field Experience

- After preparing an integrated plan for the field experience by the Field Experience Committee, the head of the department displays the topics of field experience and its location for students to choose what suits them best.
- Then the students apply to choose one of the displayed field experiences.
- Finally, the supervisor provides the student with guidelines about what kinds of tasks the student is supposed to practice at the field location.

5. Safety and Risk Management

Potential Risks	Safety Actions	Risk Management Procedures
The expulsion of trainee without compelling reasons	Sign Memorandum of Understanding (MoU) with the Field experience institute for providing training to the students.	Select Field experience institute with an agreement in advance.
Injury to the trainee during Field training	Insure for any physical injury suffered by the trainee during the training period.	Select Field experience institute with an agreement in advance.
Claim for financial reimbursements from the college against any expenditure for the completion of training program.	Contract an agreement with the Field experience institute.	Select Field experience institute with an agreement in advance.

D. Training Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Effectiveness of Training of trainee.	Student Faculty supervisor Field supervisor	Questionnaire. Reports.

Evaluation Areas/Issues	Evaluators	Evaluation Methods
	Field experience committee	
Faculty supervision	Student Faculty supervisor Field supervisor Field experience committee	Questionnaire. Reports.
Field supervision	Student Faculty supervisor Field supervisor Field experience committee	Questionnaire. Reports.

Evaluation areas (e.g., Effectiveness of Training and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

Evaluators (Students, Supervisory Staff, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

E. Specification Approval Data

Council /Committee	Physics Department Council
Reference No.	Minutes of session No.
Date	x/x/2025

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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Graduation Project	
Course Code: PHYS8912	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 7/1/2025	

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 8)					
4. Course General Description:					
Preparatory studies of the literature and data collection for the graduation project in a particular area of concentration and under the supervision of one of the faculty members. The course covers directed readings in the literature of medical physics, introduction to research methods, seminar discussions dealing with special physics topics of current interest. Planning, design, construction and management of physics projects. Writing a technical report.					
5. Pre-requirements for this course (if any)**:**					
Agreement of the Department council					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

The main aim of this course is to prepare students for the practical tasks of the workplace after graduation. This includes building his/her ability to perform a complete project.

After completing this course students should be able to deal with the following concepts:

1. Structure a working schedule for the project.
2. Present Clear aim and objectives of the graduation project.
3. Show a deep knowledge within the chosen field of physics.
4. Search and in a critical way interpret and compile relevant scientific literature.
5. In a creative way delimit a scientific problem, plan a scientific study, choose appropriate methods, carry out the study, interpret and evaluate the results and, if applicable, generate a falsifiable hypothesis to explain the observations all within given time frames.
6. Present the literature review with relation to the selected topic.
7. Write a technical report.
8. Defend the technical report in front of a committee and be able to answer questions asked by the committee members.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning	-	-
3	Hybrid ● Traditional classroom ● E-learning	-	-
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	-
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify) (compination of all above)**	45
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Defined the tools of research process.	K1	• Each student will do his project under the supervision of a staff member. • At the end of the project, students should write a scientific report. • The student	• Writing a report. • Oral presentation
1.2	Describe the research process.	K2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
			should give an oral presentation at the end of the semester.	
…				
2.0	**Skills**			
2.1	Writing a scientific report.	S1	• Each student will do his project under the supervision of a staff member. • At the end of the project, students should write a scientific report. • The student should give an oral presentation at the end of the semester.	• Writing a report. • Oral presentation
2.2	Collecting data	S2		
2.3	Analyze the results of the research	S3		
…				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	• Each student will do his project under the supervision of a staff member. • At the end of the project, students should write a scientific report. • The student should give an oral presentation at the end of the semester.	• Writing a report. • Oral presentation
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to research projects	4
2.	Defining the point of research project.	4

3.	Collecting data.	9
4.	Analyzing the results.	6
5.	Representation of the results graphically or with any suitable way.	6
6.	Writing reports on the research project.	6
7.	Reviewing the report.	4
8.	Making a poster and/or giving a presentation on the project.	6

Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Activities through the research work	All weeks	70%
2.	Writing report	All weeks	20%
3.	Final presentation	End of term	10%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	•
Supportive References	•
Electronic Materials	•
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom • Library • Laboratory
Technology equipment (projector, smart board, software)	• Software • Blackboard

Items	Resources
	• Projector
Other equipment (depending on the nature of the specialty)	• Stimulation room

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course report
The extent to which CLOs have been achieved	Instructor	Course report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification

(Bachelor)

Course Title:	Biomedical Instrumentation
Course Code:	PHYM8401
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (L8Y4)					
4. Course General Description:					

The "Biomedical Instrumentation" course provides an in-depth exploration of the principles and applications of instruments used to measure, evaluate, and treat physiological systems. Key topics include biosensors, bioelectrodes, biopotential amplifiers, and signal processing techniques for acquiring and interpreting biological signals such as ECG, EMG, and EEG. The course also covers medical imaging modalities, including ultrasound and MRI, emphasizing the design and function of the instrumentation involved. Students gain practical experience through laboratory sessions, where they build and test biomedical devices, reinforcing theoretical knowledge with hands-on application. Emphasis is placed on understanding the safety standards and regulatory requirements pertinent to medical devices. By integrating engineering principles with biological understanding, this course prepares students for careers in biomedical engineering, focusing on developing and maintaining medical instrumentation.

5. Pre-requirements for this course (if any)**:**

Fundamentals of Electronics PHYS5909

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

The primary objective of the "Biomedical Instrumentation" course is to equip students with a comprehensive understanding of the principles, design, and application of instruments used in the medical field to monitor, diagnose, and treat physiological conditions. This includes learning about various biosensors, transducers, and the electronic systems that process biological signals. Students will gain practical skills in building and testing biomedical devices, understanding safety standards, and adhering to regulatory requirements pertinent to medical instrumentation. The course aims to bridge the gap between engineering and medicine, preparing students for careers in biomedical engineering and related fields.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Define the Type of Medical Instrument and properties of Medical Instrument: Physical, thermal, electrical, and optical properties of bio-medical Instruments and their application to processing -Explain Medical Instrument Uses in medical. -Describe Medical applications	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	

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Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.2				
…				
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
…				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1	1. Electrophysiological Measurements 2. Electrocardiography	3
2	3. Circulatory System 4. Electroencephalogram	3
3	5. Electromyography (EMG)	3

	6. Respiratory Testing Instruments	
4	7. ENT and Opthalmic Instruments 8. Ultrasound Medical Diagnostic Instrumentation	3
5	9. X-Ray Instruments 10. CT Scanning	3
6	11. Magnetic Resonance Imaging (MRI) 12. Surgical Instruments	3
7	13. Some New Developments in Medical Instruments 14. Signal Processing in Medical Instruments	3
8	15. Safety Measures in Bio-Medical Instruments 16. Electro Chemical Instruments	3
9	17. Patient Monitoring System and Bio-Telemetry 18. Practical Electronic Laboratory Experiments	3
10	19. Recorders in Medical Instruments 20. Computers and Medical Data Base Management Including Web	3
...		
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6th week	30%
3	Final Exam	Term End	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1- A Textbook of Medical Instruments by S. Ananthi 2005, New Age International ISBN (13): 978-81-224-2870-4

	2- Medical Instruments and Devices Principles and Practices By Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson Copyright 2016 ISBN 9781138748521
Supportive References	Medical Instrument Design and Development: From Requirements to Market Placements Claudio Becchetti, Alessandro Neri ISBN: 978-1-119-95240-4 July 2013
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	*Medical physics Committee*
REFERENCE NO.	
DATE	1/1/2025

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Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Health Physics
Course Code:	PHYM8402
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm AlQura University
Version:	47
Last Revision Date:	*Pick Revision Date.*

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (Level 8th/4th year)					
4. Course General Description:					
This course provides a comprehensive exploration of radiation and its biological effects, focusing on the interaction of radiation with matter, cells, and living organisms. It covers foundational concepts of radiation sources, radioactivity, and transformation mechanisms, as well as the principles of cell biology to contextualize the biological impact of radiation. The course delves into the effects of radiation on human health, including deterministic and stochastic effects, carcinogenesis, and genetic implications. Additionally, it explores radiobiological models, radiological emergencies, and the management of radiation waste. Special emphasis is placed on practical applications of radiation in healthcare, industry, and environmental monitoring, with a focus on standards and practices in Saudi Arabia. Students will gain knowledge in radiation safety, health physics, and the regulatory frameworks necessary for responsible radiation use.					
5. Pre-requirements for this course (if any)**:**					
Nuclear medicine physics					
6. Co-requisites for this course (if any)**:**					
None					
7. Course Main Objective(s):					
By the end of this course, students will be able to: **1.** Identify natural and human-made radiation sources and explain their transformation mechanisms and interactions with matter.					

2. Describe how radiation interacts with cells at atomic, molecular, and cellular levels, leading to deterministic and stochastic effects such as carcinogenesis and genetic implications.
3. Outline cancer types, causes, and treatments, emphasizing the role of radiation in diagnosis and therapy.
4. Manage radiological incidents and waste disposal using international and Saudi guidelines for safety and environmental protection.
5. Discuss radiation applications in healthcare, industry, and environmental monitoring, with a focus on local practices in Saudi Arabia.
6. Apply safety protocols, signage, and labeling for radiation areas, and understand regulatory frameworks for responsible radiation use.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		

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B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Demonstrate knowledge of radiation sources, interaction mechanisms, and biological effects of radiation.	K1, K3	Lectures, case studies, guided reading	Written exams, quizzes
1.2	Explain the cellular and molecular impacts of radiation and their implications in health and disease.	K1, K2	Lectures, video-based learning, interactive group discussions	Assignments, exams
1.3	Understand the principles of radiation safety, waste management, and emergency response.	K1, K3	Lectures, real-life case analysis, group discussions	Written reports, oral presentations
1.4	Describe the applications of health physics in healthcare, industry, and environmental monitoring.	K1, K3	Guest lectures, field visits, problem-solving workshops	Case studies, project reports
2.0	**Skills**			
2.1	Apply the laws of physics to analyze data related to radiation exposure, risks, and biological effects.	S1, S2	Practical exercises, problem-solving workshops	Lab reports, data analysis assignments
2.2	Explore radiobiological models and predict outcomes in clinical	S1, S2	Modeling exercises, simulation-based learning	Problem-based projects, scenario-based assignments

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	and environmental scenarios.			
2.3	Effectively communicate radiation safety concepts, risk analysis, and emergency response strategies.	S3	Group discussions, presentations, role-play exercises	Oral presentations, participation in discussions
3.0	**Values, autonomy, and responsibility**			
3.1	Apply standards of ethical behavior and integrity in handling radiation and radioactive materials.	V1	Ethical case studies, role-playing exercises	Participation in discussions, reflective journals
3.2	Work effectively as part of a team in addressing challenges related to radiological safety and emergency response.	V2	Collaborative projects, group problem-solving tasks	Peer evaluation, self-assessment portfolios
3.3	Demonstrate responsibility and a commitment to continuous learning in radiological and health physics.	V1, V2	Collaborative workshops, review of international guidelines	Portfolio reviews, peer feedback

C. Course Content

No	List of Topics	Contact Hours
1.	1. Radiation Sources 2. Radioactivity 3. Natural Source of Radiation Exposure. 4. Exposure Eatimates. 5. Human-Made Sources of Radiation Exposure 6. Transformation Mechanisms	3

	7. Transformation Kinetics 8. Activity 9. Serial Transformation 10. Interaction of Radiation with Matter: Beta Particles – Alpha Particles – Gamma rays - Neutrons	
2.	Cell Biology 1. Cell Biology 2. Biochemistry 3. Structure of the Cell 4. Cellular Components 5. Communication of Cells with Their Environment 6. Cell Metabolism 7. Life Cycle of the Cell 8. Cellular Abnormalities	3
3.	A Brief Review of Cancer 1. Definition 2. Global Cancer Facts and Figures 3. Characteristics and Causes of Cancer Cells 4. Types of Cancer 5. Cancer Stem Cell Theory 6. Tumor Microenvironment 7. Carcinogenesis 8. Cancer as a Genetic Disease 9. Classification of Cancer 10. Methods to Diagnose Cancer 11. Cancer Treatment 12. Radiation in Cancer Treatment	4
4.	Interaction of Radiation with Cells 1. Concepts of Microdosimetry 2. Various Stages of Interaction of Radiation with Cells 3. Interaction of Radiation with Cells at the Atomic Level 4. Interaction of Radiation with Cells at the Molecular Level 5. Interaction of Radiolysis Products with Biomolecules . 6. Effects of Radiation at the Cellular Level	4
5.	Radiation Response Modifiers 1. Introduction 2. Physical Factors 3. Biological Factors 4. Chemical Factors .	3
6.	Biological Effects of Radiation: Deterministic Effects 1. Introduction 2. Early Deterministic Effects of Radiation	3

	3. Late Deterministic Effects of Radiation	
7.	Biological Effects of Radiation: Stochastic Effects—Carcinogenesis 1. Linear Nonthreshold (LNT) Hypothesis 2. Dose and Dose Rate Effectiveness Factor (DDREF) 3. Cancer Risk Estimation 4. Types of Cancer Caused by Radiation Exposure 5. Second Cancers in Radiotherapy Patients 6. Cancer Risks from Diagnostic Radiology	4
8.	Biological Effects of Radiation: Stochastic Effects—Genetic Effects 1. Genetic Effects of Radiation: Introduction 2. Genetic Diseases in Humans 3. Genetic Risk Estimation	4
9.	Radiobiological Models 1. Importance of Radiobiological Models 2. Models Based on Cell Survival Curves and Isoeffect 3. TCP- and NTCP-Based Models	3
10.	Radiological incidents and emergencies 1 Introduction 2 International Nuclear and Radiological Event Scale 3 Loss of shielding 4 Loss of containment 5 Uncontrolled criticality 6 Pre-planning for emergencies 7 The emergency organization - Regulatory Guidance - Emergency Doses for Radiation Workers - ICRP Emergency Dose Recommendations - Accident Classification - Protective Action Guidelines - Internal Uptakes - Examples of Nuclear Emergencies: Chernobyl - Accident Sequence - Radioactivity Relassed to the Environment - International Dispersal of Radioactive Materials	4
11.	Radiation Waste Management: - Classification of radioactive waste (low, intermediate, and high-level). - Storage, transportation, and disposal methods. - Local guidelines in Saudi Arabia for radioactive waste management. - Types of Radioactive Waste - Major Radioactive Nuclides - Environmental Releases	4

	- Enivronmental Monitoring Programs - Nucleasr Waste Disposal - Transportation - Package Radiation Surveys and Limits - Transport Vehicle Surveys.	
12.	Radiation Posting and Signage: - Types of radiation areas (Controlled, Supervised, and Restricted). - Required signage and labels for radiation areas and equipment. - Specific requirements in Saudi industries and healthcare facilities.	6
	Total	**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizes and Excersices	All weeks	10%
2.	Oral Presenatation and Research Project	All weeks	10%
3.	Midterm Exam	Week 7-8	30%
4.	Final Exam	Week 16-17	50%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Radiation Biology for Medical Physicists C. S. Sureka, 2017 2-Radiobiology for radiologist Hall, Eric J., 3.Herman Cember and Thomas E. Johnson "introduction to Health Physics" 4th Ed. McGraw-Hill 2009. 4. Stabin " Radiation Protection and dosimetry" , Springer 20071. 5. SFDA Requirements on Radiation Protection and Safety for Healthcare Providers
Supportive References	1. Simon Cherry, Michael E. Phelps "Physics in Nuclear Medicine" 3rd add," Saunders 2003 2.Ervin B. Podgorsak "Radiation physics for medical physicists" Springer 2006.
Electronic Materials	ICRP web sities go to http:// ICRP.org/publications.asp SFDA website, go to https://www.sfda.gov.sa/en IAEAwebsite, go to https://www.iaea.org/

Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classrooms**
Technology equipment (projector, smart board, software)	**Projector**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	- Course evaluation surveys
Effectiveness of Students assessment	Instructor	- Review of student performance data - Student feedback on assessment clarity and fairness
Quality of learning resources	Students	- Surveys on resource accessibility and usefulness
The extent to which CLOs have been achieved	Peer Reviewers	- Review of assessments and their alignment with CLOs - Analysis of student outcomes and performance
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	
REFERENCE NO.	
DATE	Ministry Of Education Umm Al-Qura University وزارة التعليم جامعة أم القرى كلية العلوم قسم الفيزياء

Course Specification
(Bachelor)

Course Title:	Computer Applications in Medical Physics
Course Code:	PHYM8403
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	28-12-204

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A. General information about the course:

1. Course Identification

1. Credit hours: (3)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required			☐ Elective	
3. Level/year at which this course is offered: (level 8.)					
4. Course General Description:					
This course is designed to cover techniques used in numerically modeling medical physical systems and analyzing data. It aims to provide students with practical experience in programming languages essential for these tasks.					
5. Pre-requirements for this course (if any)**:**					
PHYM6202 Medical Radiation Physics (2)					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The primary objective of this course is to equip students with the skills to use MATLAB for analyzing key medical physics parameters, including dose profiles, percent depth dose (PDD), and signal distributions. Through practical exercises and programming, students will develop the ability to model, process, and interpret data relevant to medical physics applications. Additionally, the course aims to enhance problem-solving skills by relating qualitative and quantitative information effectively.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom		
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	30
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		75

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define the basic knowledge of computer related to the medical signal and/or image processing.	K1	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	
1.2	Outline the basic information & communication technologies (ICT) related to medicine.	K3	Brainstorming. Cooperative learning. Dialogue and discussion. Constructivist. Self-learning.	
...	State various image quality enhancement techniques.	K3		
2.0	**Skills**			
2.1	Writing scripts and functions.	**S1, S2, S3**	-Problem-solving strategy	-Written test -Individual and group activities

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Importing, visualizing, and analyzing data.	**S2, S3**	-Cooperative learning strategy	-Written test -Individual and group activities
…	Automating repetitive tasks related to data analysis.	**S1, S2**	Problem-solving strategy	-Written test -Individual and group activities
3.0	**Values, autonomy, and responsibility**			
3.1	Demonstrating the ability to self-learn and adapt MATLAB skills to new challenges in medical physics.	**V1**	Cooperative learning	-Short quiz in class -Discussion in class
3.2	Recognizing the ethical implications of computational analyses in medical physics, particularly in areas such as patient safety, data privacy, and treatment accuracy.	**V2**	Cooperative learning	-Short quiz in class -Discussion in class
3.3	Ensuring the reliability and validity of MATLAB-based solutions for medical purposes	**V1**	Cooperative learning	-Short quiz in class -Discussion in class

C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to Matlab: -Variables and assignment statements -Numerical expressions -Characters and strings	**6**

	-Relational expressions -Random numbers -Built-in functions	
2.	Vectors and Matrices -Creating vectors -Creating matrix -Dimensions	**6**
3.	Matlab Programming: -Algorithms -Matlab scripts -Input and Output -Writing and reading -User-defined functions	**9**
4.	Selection statements: -The if statement -The if-else statement -The nested if-else statement -The elseif clause -The switch statement	**6**
5.	Medical Physics related data types Basic operations 1D, 2D and 3D data	**6**
6.	Reconstructing basic DICOM data	**3**
7.	Analyzing CT phantom images	**3**
8.	Comparing dose distributions	**3**
9.	Monte Carlo simulation (EGSnrc, FLUKA)	**3**
---	**Lab Topics** **The student will conduct experiments related to the theoretical topics discussed above.**	**30**
	Total	**75**

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D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	10%
2.	Midterm Exam	6th week	20%
3.	Lab. Final Exam	Term End	20%
4.	Final Exam	Term End	50%
5.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	A Practical Introduction to Programming and Problem Solving, 5th edition. Stormy Attaway. Elsevier 2018. ISBN: 978-0-12815-479-3.
Supportive References	An Introduction to Programming and Numerical Methods in MATLAB. Steve Otto and James Denier. Springer 2005 ISBN: 978-1-85233-919-7.
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**-Classroom** **-Library**
Technology equipment (projector, smart board, software)	**Blackboard**
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	**MEDICAL PHYSICS COMMITTEE**
REFERENCE NO.	
DATE	**1-1-2025**

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Education & Training Evaluation Commission

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2024
TP-153

Course Specification
(Bachelor)

Course Title:	Biomaterials
Course Code:	PHYM8404
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (L8Y4.)					
4. Course General Description:					
The Biomaterials course is divided into four sections: macromolecular polymer & material science, physical characterization & properties,. Biomaterials will concentrate on fundamental principles in biomedical physics and material science. This course uses a combination of lectures and student presentations, and self-directed learning to examine the structure and properties of hard materials (ceramics, metals) and soft materials (polymers, hydrogels). Specifically, the class will be divided into two parts: (I) Biomaterial Science and Engineering, (II) and Polymers					
5. Pre-requirements for this course (if any)**:**					
PHYS4907 Material Science					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
After completing this course student should be able to: 1. Define Type of Bio materials, Properties of biomaterials: Physical, thermal, electrical, and optical properties of bio-materials and their application to processing 2. Explain Biomaterials Uses in medical. 3. Describe Polymers for Medical applications 4. Explain the strategy of the course in the beginning of the semester 5. Outlines of the physical laws, principles, and the associated proofs.					

6. Highlighting the day life applications whenever exist.
7. Encourage the students to see more details in the international web sites and reference books in the library.
8. Discuss some selected problems in each chapter.
9. Cooperate with different institutions to find how they deal with the subject
10. Renew the course references frequently
11. Frequently check for the latest discovery in science

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	-Define the Type of Biomaterials and properties of biomaterials: Physical,	K1, K2	Projector Powerpoint e-learning Tutorials	

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	thermal, electrical, and optical properties of bio-materials and their application to processing -Explain Biomaterials Uses in medical. -Describe Polymers for Medical applications		Revisit concepts Discussions Brainstorming sessions	
1.2				
…				
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
…				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
…				

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C. Course Content

No	List of Topics	Contact Hours
1	**Introduction** 1 Definitions 2 Changing focus 3 Types of bonds in materials 4 Types of materials 5 Impact of biomaterials 6 Future of biomaterials	4
2	**Basic properties of materials** 1 Mechanical properties 2 Electrochemical properties 3 Surface properties	4
3	**Biological systems** 1 The biological environment 2 Genetic regulation and control systems 3 The plasma membrane 4 Cytoskeleton and motility 5 Cell communication & junctions 6 Biological testing techniques	4
4	**Characterization of biomaterials** 1 Contact angle 2 Infrared spectroscopy 3 X-ray photoelectron spectroscopy 4 Secondary ion mass spectrometry 5 Atomic force microscopy 6 Scanning electron microscopy 7 Transmission electron microscopy 8 X-ray diffraction (XRD) 9 Chromatography	4
5	**Metals: structure and properties** 1 Titanium and its alloys	2

	2 Stainless steels 3 Cobalt–chromium alloys	
6	**Polymers** 1 Molecular structure of polymers 2 Types of polymerizations 3 Physical states of polymers 4 Common polymeric biomaterials 5 Hydrogels 6 Nanopolymers	2
7	**Ceramics** 1 General properties 2 Classifications 3 Bioceramics 4 Nanoceramics	2
8	Natural biomaterials 1 Collagen 2 Elastin 3 Silk 4 Chitosan 5 Cellulose 6 Alginate 7 Hyaluronan 8 Chondroitin sulfate 9 Coral	4
9	**Surface modification** 1 Abrasive blasting 2 Plasma glow discharge treatments 3 Thermal spraying 4 Physical vapor deposition (PVD)	4
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6th week	30%
3	Final Exam	Term End	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1. Introduction to Biomaterials- Mauli Agrawal- 2014 Cambridge University Press ISBN 978-0-521-11690-9 2. BIOMATERIALS SCIENCE: An Introduction to Materials in Medicine, Edited by Buddy D. Ratner and Allan S. Hoffman.
Supportive References	BIOMATERIALS APPLICATIONS FOR NANOMEDICINE, Edited by Rosario Pignatello
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report

Assessment Areas/Issues	Assessor	Assessment Methods
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	*Medical physics Committee*
REFERENCE NO.	
DATE	1/1/2025

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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAA

2024

TP-153

Course Specification

(Bachelor)

Course Title: Nanomaterials in Medicine	
Course Code: PHYM8801	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 7/1/2025	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 8/year 4)					
4. Course General Description:					
The Nanomaterials in Medicine course offers an in-depth exploration of the unique physical properties of materials at the nanoscale and their innovative uses in the medical field. Students will delve into the fundamental principles governing nanomaterials, including quantum effects and surface phenomena, and examine how these principles differ from bulk material behaviors. The curriculum covers nanomaterials' synthesis, characterization, and functionalization, emphasizing techniques such as self-assembly and various fabrication methods. A significant focus is on medical applications, including targeted drug delivery systems, advanced imaging modalities, and diagnostic tools that leverage nanotechnology. Through a combination of theoretical instruction and practical laboratory experiences, students will gain a comprehensive understanding of how nanomaterials are revolutionizing medical diagnostics and therapeutics, preparing them for careers in nanomedicine and related fields.					
5. Pre-requirements for this course (if any)**:**					
Physics of Radiation Therapy (1) PHYM5302					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The primary objective of the Physics of Nanomaterials and their Application in Medicine" course is to provide students with a comprehensive understanding of the fundamental physical principles that govern nanomaterials and to explore their innovative applications in the medical field. This includes studying the unique properties of materials at the nanoscale, such as quantum effects and surface phenomena, and understanding how these properties can be harnessed for medical diagnostics, therapeutics, and imaging.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	Define the concepts of nanosience	K1	Lectures	Exams and lab reports
1.2				
…				
2.0	**Skills**			
2.1	Apply the concepts of nanoscience in medicine.	S1	Lectures	Exams and lab reports
2.2				
…				
3.0	**onValues, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	Work effectively individually or within a team	V1	Lectures	Exams and lab reports
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to Nanoscience** • About size scales • History • Feynman scorecard • Schrödinger's cat—quantum mechanics in small systems • Fluctuations and "Darwinian Nanoscience" • Overview of quantum effects and fluctuations in nanostructures	3
2	**Methods of Measuring Properties** • Introduction • Structure • Microscopy • Spectroscopy	3
3	**Properties of Individual Nanoparticles** • Introduction • Metal Nanoclusters • Semiconducting Nanoparticles • Rare Gas and Molecular Clusters • Theoretical Modeling of Nanoparticles • Methods of Synthesis	3
4	**Carbon Nanostructures** • Introduction • Carbon Molecules • Carbon Clusters • Carbon Nanotubes	3
5	**Applications of Carbon Nanotubes** • Computers • Fuel Cells • Chemical Sensors • Catalysis • Mechanical Reinforcement	3
6	**Nanostructured Ferromagnetism** • Basics of Ferromagnetism	3

	• Effect of Bulk Nanostructuring of Magnetic Properties • Dynamics of Nanomagnets • Nanopore Containment of Magnetic Particles • Nanocarbon Ferromagnets • Giant and Colossal • Ferrofluids	
7	**Nanomaterials, Nanostructures, and Nanotools** • Self-Assembled Organic Nanotubes: Novel Bionanomaterials for Orthopedics and Tissue Engineering • Gold Nanoparticles with Organic Linkers for Applications in Biomedicine • Nucleoprotein-Based Nanodevices in Drug Design and Delivery • Bimetallic Nanoparticles: Synthesis and Characterization • Nanotube-Based Membrane Systems • Nanoimaging of Biomolecules Using Near-Field Scanning Optical Microscopy • Development and Modeling of a Novel Self-Assembly Process for Polymer and Polymeric Composite Nanoparticles • Cellular Interfacing with Arrays of Vertically Aligned Carbon Nanofibers and Nanofiber-Templated Materials • Single-Molecule Detection Techniques for Monitoring Cellular Activity at the Nanoscale Level	3
8	**Applications in Biology and Medicine** • Synthetic Biology: From Gene Circuits to Novel Biological Tools • Recent Trends in Nanomaterials Integration into Simple Biosensing Platforms • Bioelectrochemistry • Monitoring Apoptosis and Anticancer Drug Activity in Single Cells Using Nanosensors • Biosensing and Theranostics Applications of Gold Nanostars • A Fractal Analysis of Binding and Dissociation Kinetics of Glucose and Related Analytes on Biosensor Surfaces at the Nanoscale Level • Integrated Cantilever-Based Biosensors for the Detection of Chemical and Biological Entities	3
9	**Nanomaterials in Medicine** • Drug delivery systems utilizing nanoparticles. • Nanoparticles in imaging modalities (MRI, CT, PET). • Therapeutic applications: photothermal therapy, targeted cancer treatment.	3
10	**Safety and Ethical Considerations:** • Biocompatibility and toxicity assessments. • Regulatory frameworks for medical nanomaterials.	3

Total	30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8th week	30%
2.	HomeWorks & Quizzes	All weeks	20%
3.	Final Exam	End of term	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	• Introduction to nanotechnology Charles P. Poole, Jr Wiley 2003 ISBN 0-471 -07935-9 • Nanotechnology An Introduction, Jeremy Ramsden,2nd edition, 2016, Elsevier. ISBN 9780323393140
Supportive References	• Nanotechnology in Biology and Medicine 2nd add Tuan Vo-Dinh2018 by Taylor
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	• Classroom
Technology equipment (projector, smart board, software)	• Blackboard • Projector
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of	Instructor	Exams

Assessment Areas/Issues	Assessor	Assessment Methods
Students assessment		
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physics Department Council
REFERENCE NO.	Minutes of session No. xx
DATE	x/x/2025

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Education & Training Evaluation Commission

اعتماد
NCAA

2024
TP-153

Course Specification
(Bachelor)

Course Title:	Nonionizing radiation in medicine
Course Code:	PHYM8802
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 8/year 4)					

4. Course General Description:

The "Non-Ionizing Radiation in Medicine" course provides a comprehensive overview of non-ionizing radiation types and their medical applications. It covers the physics of non-ionizing radiation, including ultraviolet (UV), visible light, infrared (IR), microwaves, radiofrequency (RF), and extremely low frequency (ELF) waves. The course emphasizes the safe use of non-ionizing radiation-producing devices, such as lasers in medicine, UV light in dermatological treatments, and RF in magnetic resonance imaging (MRI). Students will explore the biological effects of non-ionizing radiation, safety standards, and protection measures to mitigate potential health risks. Through lectures and practical sessions, the course aims to equip students with the knowledge to evaluate hazards, implement safety protocols, and understand the therapeutic and diagnostic applications of non-ionizing radiation in clinical settings.

5. Pre-requirements for this course (if any):

Physics of Medical Imaging (1) PHYM5303

6. Co-requisites for this course (if any):

7. Course Main Objective(s):

The primary objective of the "Non-Ionizing Radiation in Medicine" course is to equip students with a comprehensive understanding of the physical principles, biological effects, and medical applications of non-ionizing radiation. This includes modalities such as ultraviolet (UV), visible light, infrared (IR), microwaves, radiofrequency (RF), Magnetic Resonance Imaging (MRI), Ultrasound (US) imaging, and laser technologies. The course emphasizes safety protocols, quality assurance measures, and adherence to international guidelines to ensure the effective and secure use of these technologies in clinical settings.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom		

No	Mode of Instruction	Contact Hours	Percentage
	• E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	-Define the Type of Non-Ionizing Radiation and properties of Non-Ionizing Radiation : Physical, properties of Non-Ionizing Radiation and their application to processing -Explain Non-Ionizing Radiation Uses in medical. -Describe Non-Ionizing Radiation s for Medical applications	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	
1.2				
...				

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
…				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1	**Ultraviolet (UV) Radiation:** Fundamentals: Understanding UV radiation properties and classifications. Medical Applications: Utilization in dermatological treatments and sterilization processes.	6

	Safety Protocols: Implementing measures to protect patients and healthcare workers from potential hazards.	
2	**Infrared (IR) Radiation:** Principles: Exploring IR radiation characteristics and interactions with biological tissues. Therapeutic Uses: Applications in physical therapy and rehabilitation. Safety Measures: Guidelines to prevent overexposure and ensure safe therapeutic practices.	4
3	**Radiofrequency (RF) Radiation:** Basics: Understanding RF radiation and its interaction with human tissues. Diagnostic Tools: Role in Magnetic Resonance Imaging (MRI) and other diagnostic modalities. Safety Considerations: Addressing potential risks and establishing exposure limits to protect patients and staff.Radioactive “Bullets” – Alpha-Immunotherapy	4
4	**Laser Radiation:** Operation Principles: Fundamentals of laser technology and various types used in medicine. Clinical Applications: Use in surgical procedures, ophthalmology, and dermatology. Safety Standards: Implementing protocols to prevent accidental exposure and ensure safe operation.	6
5	**Magnetic Fields:** Static and Time-Dependent Fields: Understanding the properties and effects of magnetic fields in medical diagnostics and treatments. Applications: Use in MRI and other medical devices. Safety Protocols: Ensuring safe exposure levels for patients and healthcare workers.	**4**
6	**Electromagnetic Fields (EMF):** Overview: Understanding EMF sources and their interactions with biological tissues. Health Implications: Evaluating potential health risks associated with EMF exposure. Regulatory Standards: Familiarization with guidelines and regulations governing EMF exposure in medical settings.	**4**

7	**Regulatory and Ethical Considerations:** Legislation: Understanding laws and regulations related to the use of non-ionizing radiation in medicine. Ethical Practices: Ensuring informed consent and ethical use of non-ionizing radiation in patient care.	4
	Total	30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6th week	30%
3	Final Exam	Term End	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Introduction to Health Physics Thomas E. Johnson 2017 by McGraw-Hill ISBN: 978-0-07-183526-8
Supportive References	2-Non-ionizing Radiation Protection by Andrew W. Wood 2017 Wiley
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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Course Specification
(Bachelor)

Course Title: Isotopes in Medicine	
Course Code: PHYM8803	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 30-12-2024	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered:(Level 8/year 4)					
4. Course General Description:					
The course "Isotopes in Medicine" explores the fundamental principles and applications of radioactive isotopes in medical diagnosis, treatment, and research. It provides an overview of the production, properties, and safe handling of medical isotopes, emphasizing their role in nuclear medicine. Topics include the use of isotopes in imaging techniques such as PET and SPECT, therapeutic applications in oncology (e.g., radioisotopes like Iodine-131 and Lutetium-177), and their role in laboratory diagnostics such as radioimmunoassay (RIA). The course highlights radiation safety protocols, regulatory guidelines, and the biological effects of radiation. Through lectures, case studies, and practical sessions, students will gain a comprehensive understanding of how isotopes contribute to advancements in medical science, enabling accurate diagnosis and effective treatments while ensuring patient and staff safety.					
5. Pre-requirements for this course (if any)**:**					
Nuclear medicine physics PHYM5301					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The main objective of the "Isotopes in Medicine" course is to provide students with a comprehensive understanding of the principles, production, and applications of radioactive isotopes in medical science. The course aims to equip students with the knowledge needed to utilize isotopes effectively in diagnostic imaging, treatments, and research, focusing on safety and regulatory compliance. It emphasizes the role of isotopes in advancing medical technologies, improving patient outcomes, and addressing challenges in nuclear medicine. By the end of the course, students will be prepared to apply their knowledge in clinical or research settings, ensuring the safe and effective use of isotopes in various medical applications.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Define the Type of Isotopes and properties of isotopes: Physical, properties of isotopes and their application to processing -Explain Isotopes Uses in medical. -Describe Isotopess for Medical applications	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	
1.2				

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
...				
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
...				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to Isotopes** How Constant is the Decay Constant Natural Transmutation by Radioactive Decay Synthesis of Superheavy Elements by Transmutation	4

	Laser Transmutation	
2	**Stable Isotopes** Metabolic Studies Metabolic Flux Analysis (MFA) Metabolite Profiling Energy Metabolism Drug Development Drug Metabolism Studies Deuterated Drugs Pharmacokinetic Studies Assess drug pharmacology, bioavailability, and patient-specific responses.	6
3	**Radioisotopes in Medicine** Imaging External Beam Radiotherapy Brachytherapy Immunotherapy Ion Beam Therapy Boron Neutron Capture Therapy Radioactive “Bullets” – Alpha-Immunotherapy	6
4	**Scientific and Industrial Applications** Radioisotope Tracers Radiography and Gauging Radiation Processing Nuclear Batteries	6
5	**Radiation and the Environment** Biological Effects of Ionising Radiation Radiotoxicity and Annual Limits of Intake Radiation Hormesis and the Linear Non-Threshold (LNT) Model High Background Radiation Areas Around the World	4
6	Radon: A Test for the LNT Hypothesis? Radiation Exposure in High-Flying Aircraft Conan the Bacterium	4

	Packaging and Transport of Radioactive Materials Nuclear Waste Disposal Nuclear Tests in the South Pacific The Chernobyl Accident The Goiˆania Radiation Incident – a Benchmark for Radiological Dispersion Devices (RDDs) .	
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6th week	30%
3	Final Exam	Term End	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Radioactivity Radionuclides Radiation -Joseph Magill ISBN 3-540-21116-0 Springer 2005 2-Isotopes for Medicine and the Life Sciences S. James Adelstein and Frederick J. Manning, Editors 1995 Paperback: 978-0-309-05190-3 Ebook: 978-0-309-17669-9 3-Radionuclide Therapy Bekiş, R., Polack, B., & Bozkurt, M. F. (2022). Springer. ISBN: 978-3-030-97219-6.
Supportive References	Radioimmunoassay in Basic and Clinical Pharmacology by Carlo Patrono, Bernhard A. Peskar 1987, ISBN: 978-3-642-71811-3
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord

Items	Resources
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

Ministry Of Education
Umm Al-Qura University
وزارة التعليم
جامعة أم القرى
كلية العلوم
قسم الفيزياء

هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: Medical biophysics	
Course Code: PHYM8804	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 30-12-2024	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered:(Level 8/year 4)					

4. Course General Description:

The "Medical Biophysics" course explores the application of physics principles to biological systems and medical practices. It delves into the physical mechanisms underlying physiological processes, such as cardiovascular and respiratory functions, and examines how these principles inform medical diagnostics and treatments. Key topics include biomechanics, fluid dynamics in blood flow, medical imaging techniques like MRI and ultrasound, and the biophysics of cellular processes. The course emphasizes quantitative analysis and modeling to understand complex biological functions, preparing students for advanced studies or careers in medical physics, biomedical engineering, or related fields. Through a combination of lectures, laboratory work, and case studies, students gain a comprehensive understanding of how physical laws govern biological systems and their applications in medicine.

5. Pre-requirements for this course (if any)**:**

Medical Radiation Physics (2) PHYM6202

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

The primary objective of the "Medical Biophysics" course is to equip students with a comprehensive understanding of the physical principles underlying biological systems and their applications in medicine. This interdisciplinary approach enables students to apply quantitative and analytical methods to complex biological processes, bridging the gap between fundamental science and clinical practice. The course emphasizes the development of skills in critical thinking, problem-solving, and the application of physics-based techniques to medical diagnostics and treatments. By integrating knowledge from physics, biology, and medicine, students are prepared for careers in medical physics, biomedical engineering, and related fields, contributing to advancements in healthcare technologies and methodologies.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		

No	Mode of Instruction	Contact Hours	Percentage
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Define the Type of Isotopes and properties of isotopes: Physical, properties of isotopes and their application to processing -Explain Isotopes Uses in medical. -Describe Isotopess for Medical applications	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	
1.2				
...				
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
...				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1	Cellular Biophysics: *Membrane Dynamics:* Understanding the physical principles governing structure and function. *Signal Transduction:* Exploring how cells communicate through physical and c	4
2	Cardiovascular Biophysics:	4

	Hemodynamics: Studying blood flow dynamics and the mechanical prop vessels. *Cardiac Mechanics:* Analyzing the physical forces involved in heart function.	
3	Respiratory Biophysics: *Gas Exchange Mechanics:* Investigating the physical processes of oxygen anc exchange in the lungs. *Lung Mechanics:* Examining the biomechanical aspects of breathing and lun	4
4	Neurobiophysics: *Neuronal Signaling:* Understanding the electrical properties of neurons and n *Sensory Systems:* Exploring the biophysical mechanisms underlying sensory	4
5	Radiation Biophysics: Radiation Therapy: Application of ionizing radiation in cancer treatment. Radiation Safety: Principles of radiation protection and dosimetry. Biomechanics: Musculoskeletal Mechanics: Studying the mechanical properties of bones, muscles, and joints. Movement Analysis: Understanding the physics of human motion.	4
6	Thermodynamics in Biological Systems: Energy Transfer: Exploring how energy is transformed and utilized in biological processes. Entropy and Life: Understanding the role of thermodynamics in living organisms.	4
7	Molecular Biophysics: Protein Dynamics: Studying the physical properties and behaviors of proteins. DNA/RNA Mechanics: Understanding the structural dynamics of nucleic acids.	6
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	**Homework, Quizzes, and scientific activities**	**All weeks**	**20%**
2.	**Midterm Exam**	**6^{th} week**	**30%**
3	**Final Exam**	**Term End**	**50%**
4.	**Total**		**100%**

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Radioactivity Radionuclides Radiation -Joseph Magill ISBN 3-540-21116-0 Springer 2005 2-Isotopes for Medicine and the Life Sciences S. James Adelstein and Frederick J. Manning, Editors 1995 Paperback: 978-0-309-05190-3 Ebook: 978-0-309-17669-9 3-Radionuclide Therapy Bekiş, R., Polack, B., & Bozkurt, M. F. (2022). Springer. ISBN: 978-3-030-97219-6.
Supportive References	Radioimmunoassay in Basic and Clinical Pharmacology by Carlo Patrono, Bernhard A. Peskar 1987, ISBN: 978-3-642-71811-3
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	Ministry Of Education Umm Al-Qura University وزارة التعليم جامعة أم القرى كلية العلوم قسم الفيزياء

DATE	1/1/2025

Ministry Of Education
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هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

اعتماد
NCAAA

2024
TP-153

Course Specification
(Bachelor)

Course Title: PHYM8805 Biosensors	
Course Code: PHYM8805	
Program: Medical Physics	
Department: Physics	
College: Science	
Institution: Umm Al-Qura University	
Version: 47	
Last Revision Date: 30-12-2024	

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 8/year 4)					

4. Course General Description:

Biosensors combine biological recognition elements and signal conversion elements into a biodetection system. They have been developed for a wide variety of biodetection applications, offering the advantages of increased speed and ease of use compared to traditional detection methods. In Biosensors and Biodetection: Methods and Protocols, leading experts describe the major technologies in the field in extensive technical detail, allowing readers both to understand the technology and to construct similar devices. Electrochemical and Mechanical Detectors, Lateral Flow, and Ligands for Biosensors focus on direct measurement sensors, indirect methods, ligands, and related technologies, including methods involving electrochemical detectors, recognition ligands, antibodies, aptamers, and peptides, amongst many other subjects.

5. Pre-requirements for this course (if any)**:**

Radiation protection and dosimetry PHYM8203

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

This course is designed to demonstrate and consolidate the physical principles of biosensors used in medicine and biology and operation of related equipment, lecture include;

1 Sensors
2 Transducers
3 Biosensors
4 Bioreceptors
5 Transducers for Biosensors

2. Teaching mode (mark all that apply)

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No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid ● Traditional classroom ● E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**			
1.1	-Define the Type of Isotopes and properties of isotopes: Physical, properties of isotopes and their application to processing -Explain Isotopes Uses in medical. -Describe Isotopess for Medical applications	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	
1.2				

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
…				
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
…				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1	**Introduction to Sensors** 1 Sensors 2 Transducers	2

	3 Biosensors 4 Bioreceptors 5 Transducers for Biosensors	
2	**Temperature Sensors** 1 Thermocouple 2 Thermistor 3 Diode Temperature Sensor 4 Transistor Temperature Sensor	2
3	**Light Sensors** 1 Light 2 Photoresistor 3 Photodiode 4 Phototransistor 5 Light-Emitting Diode (LED) 6 Laser Diode	4
4	**Spectrophotometry** 1 Spectrophotometry 2 Spectrophotometry Biosensor Example: Pulse Oximeter 3 Miniature Spectrophotometer 4 Optical Fibers	2
5	**Fluorescence** 1 Fluorescence 2 Fluorescent Dyes 3 Advanced Fluorescent Dyes: GFP, SYBR, and QD 4 Autofluorescence 5 Detection of Fluorescence 6 Laboratory	4
6	**Electrochemical Sensors** 1 Electrolytic and Electrochemical Cells 2 Ion-Selective Electrodes (ISEs; Potentiometric) 3 pH Electrode (Potentiometric)	4

	4 Amperometric Biosensors 5 Conductometric Biosensors	
7	**Piezoelectric Sensors** 1 Piezoelectricity 2 Pressure Sensors 3 Crystal Oscillators 4 Quartz Crystal Microbalance (QCM) 5 Viscoelasticity Consideration in QCM 6 Flow Cell QCM as Biosensor	2
8	**Glucose Sensors** 1 Optical Glucose Sensor 2 Electrochemical Glucose Sensor 3 Other Electrochemical Biosensors 4 Continuous Glucose Monitoring (CGM)	2
9	Immunosensors 1 Enzyme-Linked Immunosorbent Assay (ELISA) 2 Antibody Fragments and Aptamers 3 Lateral-Flow Assay (LFA) 4 Optical Immunosensors 5 Piezoelectric Immunosensors: QCM Immunosensor 6 Immunosensing Kits Versus Handheld Immunosensors	4
10	**Nanobiosensors** 1 Gold Nanoparticles (AuNPs) 2 Quantum Dots (QDs) 3 Zinc Oxide (ZnO) Nanostructures 4 Carbon Nanotubes (CNTs) and Graphene 5 Nanoporous Gold	4
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6^{th} week	30%
3	Final Exam	Term End	50%
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Introduction to Biosensors Jeong Yeol 2nd Edition Springer 2016 ISBN 978-3-319-27411-9 2- Biosensors and Biodetection John M. Walker Humana Press, 2009 ISBN: 978-1-60327-568-2
Supportive References	
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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Education & Training Evaluation Commission

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2024
TP-153

Course Specification
(Bachelor)

Course Title:	Medical Image Processing
Course Code:	PHYM8806
Program:	Medical Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	30-12-2024

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Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (2)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 8/year 4)					

4. Course General Description:

Biosensors combine biological recognition elements and signal conversion elements into a biodetection system. They have been developed for a wide variety of biodetection applications, offering the advantages of increased speed and ease of use compared to traditional detection methods. In Biosensors and Biodetection: Methods and Protocols, leading experts describe the major technologies in the field in extensive technical detail, allowing readers both to understand the technology and to construct similar devices. Electrochemical and Mechanical Detectors, Lateral Flow, and Ligands for Biosensors focus on direct measurement sensors, indirect methods, ligands, and related technologies, including methods involving electrochemical detectors, recognition ligands, antibodies, aptamers, and peptides, amongst many other subjects.

5. Pre-requirements for this course (if any)**:**

Physics of Medical Imaging (2) PHYM6306

6. Co-requisites for this course (if any)**:**

7. Course Main Objective(s):

This course is designed to demonstrate and consolidate the physical principles of biosensors used in medicine and biology and operation of related equipment, lecture include;

1 Sensors
2 Transducers
3 Biosensors
4 Bioreceptors
5 Transducers for Biosensors

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	30	100%
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	30
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		30

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.0	Knowledge and understanding			
1.1	-Define the Type of Medical image processing and properties of Medical image processing: Physical, properties of Medical image processing and their application to processing	K1, K2	Projector Powerpoint e-learning Tutorials Revisit concepts Discussions Brainstorming sessions	

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	-Explain Medical image processing Uses in medical. -Describe Medical image processings for Medical applications			
1.2				
…				
2.0	**Skills**			
2.1		S1,S2,S4	- Lectures - -Discussion	Exams contain questions that can measure these skills. - Quiz and exams -Discussions after the lecture
2.2				
…				
3.0	**Values, autonomy, and responsibility**			
3.1	- work effectively in a group to make a decision. -Analyse obtained data and how to manage it. -make a certain decision fast, especially during data acquisition.	V1,V2,V3	- Case Study - Active learning - Small group discussion	Evaluate the efforts of each student in preparing the report. Evaluate the scientific values of reports. Evaluate the work in the team Evaluation of the role of each student in lab group assignment Evaluation of students presentations
3.2				
…				

C. Course Content

No	List of Topics	Contact Hours
1	**1-Medical imaging modalities** Images from x-rays Images from γ-rays Ultrasound imaging Magnetic resonance imaging Picture archiving and communication systems (PACS)	4
2	**2-Fundamentals of digital image processing** The gray-level histogram Histogram transformations and look-up tables	2
3	**Image enhancement in the spatial domain** Algebraic operations Logical (Boolean) operations Geometric operations Convolution-based operations	2
4	**3-Image enhancement in the frequency domain** The Fourier domain The Fourier transform Properties of the Fourier transform, Sampling Cross-correlation and autocorrelation Imaging systems – point spread function and optical transfer function Frequency domain filters Tomographic reconstruction	4
5	**-Image Restoration** Image degradation Noise Noise-reduction filters Blurring Modeling image degradation Geometric degradations	4
6	**Morphological image processing**	2

	Mathematical morphology Morphological operators Extension to grayscale images	
7	**Image segmentation** .1 What is segmentation? .2 Thresholding .3 Region-based methods .4 Boundary-based methods .5 Other methods	4
8	**Feature recognition and classification** .1 Object recognition and classification .2 Connected components labeling .3 Features .4 Object recognition and classification .5 Statistical classification .6 Structural/syntactic classification .7 Applications in medical image analysis	4
9	**Three-dimensional visualization** .1 Image visualization .2 Surface rendering .3 Volume rendering .4 Virtual reality	4
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework, Quizzes, and scientific activities	All weeks	20%
2.	Midterm Exam	6^{th} week	30%
3	Final Exam	Term End	50%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Total		100%

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	1-Digital Image Processing for Medical Applications, Geoff Dougherty, Cambridge University Press 2009, ISBN-13 978-0-511-53343-3. 2-Quantitative Analysis in Nuclear Medicine Imaging Habib Zaidi 2006 Springer ScienceBusiness Media, Inc. ISBN-13: 978-0387-23854-8
Supportive References	Introduction to radiological physics and radiation dosimetry Frank Herbert- Wiley 2004, ISBN-13: 978-0-471-01 146-
Electronic Materials	
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1- Classroom 2- Library
Technology equipment (projector, smart board, software)	1- Data show 2- Black Bord
Other equipment (depending on the nature of the specialty)	

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Questionnaire
Effectiveness of Students assessment	Instructor	Exams
Quality of learning resources	Instructor	Course Report
The extent to which CLOs have been achieved	Instructor	Course Report
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify)

Assessment Methods (Direct, Indirect)

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G. Specification Approval

COUNCIL /COMMITTEE	Medical physics Committee
REFERENCE NO.	
DATE	1/1/2025

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