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

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	4

	• Vectors and the Laws of Physics • Multiplying Vectors	
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%
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)

Assessment Areas/Issues	Assessor	Assessment Methods
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

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

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	-	-

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	
REFERENCE NO.	
DATE	

Course Specification
(Bachelor)

Course Title:	**Linear Algebra 1**
Course Code:	**MTH1401**
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.	
DATE	

Course Specification
(Bachelor)

Course Title:	Introduction to Mathematical Physics
Course Code:	MTH1131
Program:	Physics
Department:	Mathematics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

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 1/1 year)					
4. Course General Description:					
The purpose of this course is to give introduction to mathematical methods used in physics. This course concentrates on different techniques which help to solve a variety of problems in physics.					
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.** Infinite series, power series. **2.** Vector analysis. **3.** Complex numbers.					

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 vectors quantities and their properties.	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe the properties of complex numbers and some basic complex functions.	K2		
2.0	Skills			
2.1	Apply the methods of vector calculus to physical problems.	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Demonstrate the use of series and expansions of trigonometric, exponential and logarithmic functions.	S2		
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Infinite series, power series • The Geometric Series • Applications of Series • Convergent and Divergent Series • Testing Series for Convergence; the Preliminary Test • Convergence Tests for Series of Positive Terms: Absolute Convergence • Alternating Series • Conditionally Convergent Series • Power Series; Interval of Convergence • Theorems About Power Series • Expanding Functions in Power Series • Techniques for Obtaining Power Series Expansions • Multiplying a Series by a Polynomial or by Another Series • Division of Two Series or of a Series by a Polynomial • Binomial Series • Substitution of a Polynomial or a Series for the Variable in Another Series • Combination of Methods • Taylor Series Using the Basic Maclaurin Series	10
2.	Vector analysis • Scalars and vectors • Addition and subtraction of vectors • Multiplication by a scalar • Basis vectors and components • Magnitude of a vector • Multiplication of vectors • Equations of lines, planes and spheres • Using vectors to find distances • Reciprocal vectors • Differentiation of vectors • Integration of vectors • Space curves • Vector functions of several arguments • Surfaces • Scalar and vector fields	10

	• Vector operators • Vector operator formulae • Cylindrical and spherical polar coordinates • General curvilinear coordinates	
3.	Complex numbers • Real and Imaginary Parts of a Complex Number • The Complex Plane • Terminology and Notation • Complex Algebra • Complex Infinite Series • Complex Power Series; Disk of Convergence • Elementary Functions of Complex Numbers • Euler's Formula • Powers and Roots of Complex Numbers • The Exponential and Trigonometric Functions • Hyperbolic Functions • Some Applications	**10**
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• Mary L. Boas, Mathematical methods in the Physical sciences, Third edition, John Wiley and Sons (2006). ISBN-13: 978- 0471198260 • George B. Arfken, Hans J. Weber, Frank E. Harris , Mathematical Methods for Physicists: A Comprehensive Guide, 7th edition, Academic Press is an imprint of Elsevier (2013), ISBN-13: 978-0-12- 384654-9.

Supportive References	• K. F. Riley, M. P. Hobson, and S. J. Bence, Mathematical Methods for Physics and Engineering, 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	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:	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

Table of Contents

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 PHYS1101					
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	
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

Items	Resources
	• 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

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	

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)

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

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	

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**

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.	
DATE	

Course Specification
(Bachelor)

Course Title:	Heat and Waves
Course Code:	PHYS2103
Program:	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: (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 general physics, such as oscillations, wave mechanics, temperature, and heat and laws of thermodynamics, kinetic theory of gas, and waves interference and diffraction.					
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.** oscillation and wave motion. **2.** oscillations **3.** motion in one dimension, circular motion and vibration. **4.** wave motions. **5.** temperature, Heat, and first law of thermodynamics, kinetic theory of gas. **6.** Interference and diffraction. **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	-	-
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	Define the physical properties of vibration and waves	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Describe the effects of interference and diffraction	K2		
…				
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Solve problems related to waves and vibration.	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Apply physics laws to solve problems related to the laws of thermodynamics.	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 and lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Oscillations** ● Simple Harmonic Motion ● The Force Law for Simple Harmonic Motion ● Energy in Simple Harmonic Motion ● An Angular Simple Harmonic Oscillator ● Pendulums ● Simple Harmonic Motion and Uniform Circular Motion ● Damped Simple Harmonic Motion ● Forced Oscillations and Resonance	6
2.	**Waves-I** ● Types of Waves ● Transverse and Longitudinal Waves ● Wavelength and Frequency ● The Speed of a Traveling Wave ● Wave Speed on a Stretched String ● Energy and Power of a Wave Traveling Along a String ● The Wave Equation ● The Principle of Superposition for Waves ● Interference of Waves ● Phasors ● Standing Waves	6

	• Standing Waves and Resonance	
3.	**Waves-II** • Sound Waves • The Speed of Sound • Traveling Sound Waves • Interference • Intensity and Sound Level • Sources of Musical Sound • Beats • The Doppler Effect • Supersonic Speeds, Shock Waves	6
4.	**Temperature, Heat, and First Law of Thermodynamics** • Temperature • The Zeroth Law of Thermodynamics • Measuring Temperature • The Celsius and Fahrenheit Scales • Thermal Expansion • Temperature and Heat • The Absorption of Heat by Solids and Liquids • A Closer Look at Heat and Work • The First Law of Thermodynamics • Some Special Cases of First Law of Thermodynamics • Heat Transfer Mechanisms • Systems with Varying Mass: a Rocket	6
5.	**The Kinetic Theory of Gases** • Avogadro's Number • Ideal Gases • Pressure, Temperature, and *rms* Speed • Translational Kinetic Energy • Mean Free Path • The Distribution of Molecular Speeds • The Molar Specific Heats of an Ideal Gas • Degrees of Freedom and Molar Specific Heats • The Adiabatic Expansion of an Ideal Gas	6
6.	**Entropy and the Second Law of Thermodynamics** • Entropy • Entropy in the Real World: Engines • Refrigerators and Real Engines • A Statistical View of Entropy	6
7.	**Interference** • Light As a Wave • Young's Interference Experiment • Interference and Double-Slit Intensity • Interference from Thin Films • Michelson's Interferometer	5

8.	**Diffraction** ● Single-Slit Diffraction ● Intensity in Single-Slit Diffraction ● Diffraction By a Circular Aperture ● Diffraction By a Double Slit ● Diffraction Gratings ● Gratings: Dispersion and Resolving Power ● X-Ray Diffraction	4
9.	**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		**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	
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

Course Specification
(Bachelor)

Course Title:	Classical Mechanics
Course Code:	PHYS2501
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	5/1/2025

Table of Contents

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 3/2nd Year)					
4. Course General Description:					
The course covers vector algebra and vector differentiation, Newton's Laws of motion and the rectilinear motion of a single particle. Also, the course covers the simple harmonic motion, the damped and forced harmonic oscillator. The course covers the general motion of a particle in three dimensions. Indeed, the study of non-inertial reference systems, as well as the central forces and celestial mechanics. The motion of a system of many particles is also covered in the course.					
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. Rectilinear motion of a single particle using vector algebra. 2. Damped and forced harmonic motion mathematically. 3. Equations of motion of a falling body in resisting medium. 4. Constrained motion of a particle. 5. Motion of particle in rotating coordinate system. 6. Motion of a particle in a central field. 7. Kepler's laws of planetary motion. 8. Energy equation of the orbit and the periodic time of orbital motion. 9. Center of mass, angular momentum, and kinetic energy of a system of particles. 10. Motion of two interacting bodies using mathematics.					

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**	60
2.	**Laboratory/Studio**	-
3.	**Field**	-
4.	**Tutorial**	
5.	**Others (specify)**	-
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	Define the physical quantities related to the motion of a single particle.	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe Kepler's laws of planetary motion using mathematics.	K2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	Apply Newton's laws to solve problems.	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Identify appropriate models for solving problems related to the motion of a particle in a central field using mathematics.	S2		
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				

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.	**10**

	• Forced harmonic motion: resonance.	
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. • Simple pendulum. • More accurate solution of the simple pendulum problem.	**12**
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.	**10**
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. • 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. • Orbital energies in an inverse-square field.	**12**
6.	**Dynamics of Systems of Particles** • Introduction. • 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.	**10**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	Analytical Mechanics by G.R. Fowles and G. L. Cassiday (2005), 7th edition.
Supportive References	Classical Mechanics by John R. Taylor (2005).
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 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:	Electricity and magnetism
Course Code:	PHYS2301
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

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 and AC current.					
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 deal with the following concepts: **1.** the fundamental properties of the electric charge **2.** electric field at a point due to electric charge. **3.** electric potential. **4.** electric flux. **5.** capacitance. **6.** electric current, current density Ohm's Law, Kirchhoff's laws, and RC circuits. **7.** magnetic field. **8.** AC circuit **9.** 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	105	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**	60
2.	**Laboratory/Studio**	45
3.	**Field**	-
4.	**Tutorial**	-
5.	**Others (specify)**	-
Total		105

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, Coulomb 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 phenomenon 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 DC current variables to AC current variables	S1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
2.2	Calculate the magnetic field.	S2		
2.3	Analyze electric circuit theoretically and experimentally	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
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.	5
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,	6
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.	5
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.	6
5.	Capacitance	5

	● 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.	
6.	Current and Resistance ● Electric currents, current density, resistance and resistivity, ohm's law, power in electric circuits. semiconductors, superconductors.	5
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.	6
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.	5
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.	6
10.	Induction and Inductance ● Faraday's law of induction, Lenz's law. induction and energy transfers, induced electric fields, inductors and inductance, self-induction, RL circuits, energy stored in a magnetic field, energy density of a magnetic field, mutual induction, a current-carrying coil as a magnetic dipole.	6
11.	Electromagnetic Oscillations and Alternating Current ● LC oscillations, damped oscillations in an RLC circuit, forced oscillations of three simple circuits, the series RLC circuit, power in alternating-current circuits, transformers	5
12.	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		**105**

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	
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 (direct)
Effectiveness of Students assessment	Instructor	Peer review of exam marking (direct)
Quality of learning resources	Instructor	Course report (direct)

Assessment Areas/Issues	Assessor	Assessment Methods
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

Course Specification
(Bachelor)

Course Title:	Intermediate Mathematical Physics
Course Code:	MTH2132
Program:	Physics
Department:	Mathematics
College:	Scinece
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

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 3/2 year)					
4. Course General Description:					
This course aims to present mathematical techniques applied to physics. This course focuses on several methods that aid in resolving a range of physics issues. These mathematical techniques including : partial differentiation, multiple integrals, curvilinear coordinates and special functions.					
5. Pre-requirements for this course (if any)**:**					
Introduction to Mathematical Physics MTH1131					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course is designed to familiarize students with essential mathematical methods for solving advanced problems in theoretical physics. These mathematical techniques including : 1. Partial differentiation, 2. Special functions, 3. Multiple integrals, 4. Special functions.					

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		

No	Mode of Instruction	Contact Hours	Percentage
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	Describe the method of using partial differentiation to formulate real problems in physics.	K1	Lectures	Exams, Quizzes, Homework.
1.2	Recognize basic expressions of special functions such as Gamma and	K2		
1.3				
2.0	Skills			
2.1	Calculate double and triple Integrals	S1	Lectures	Exams, Quizzes, Homework.
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects	V1	Lectures.	Exams, Quizzes, Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	with high professionalism.			
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Partial differentiation • Introduction and notation • Power series in two variables • Total differentials • Approximations using differentials • Chain rule or differentiating a function of a function • Implicit differentiation • More chain rule • Application of partial differentiation to maximum and minimum • Problems • Maximum and minimum problems with constraints; lagrange multipliers • Endpoint or boundary point problems • Change of variables • Differentiation of integrals; leibniz' rule	6
2.	Multiple integrals • Double and triple integrals • Applications of integration; single and multiple integrals • Change of variables in integrals; jacobians • Surface integrals	6
3.	Special functions • The factorial function • Definition of the gamma function; recursion relation • The gamma function of negative numbers • Some important formulas involving gamma functions • Beta functions • Beta functions in terms of gamma functions • The error function • Asymptotic series • Stirling's formula • Elliptic integrals and functions	18

Total	30

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• Mary L. Boas, Mathematical methods in the Physical sciences, Third edition, John Wiley and Sons (2006). ISBN-13: 978- 0471198260 • George B. Arfken, Hans J. Weber, Frank E. Harris , Mathematical Methods for Physicists: A Comprehensive Guide, 7th edition, Academic Press is an imprint of Elsevier (2013), ISBN-13: 978-0-12- 384654-9.
Supportive References	• K. F. Riley, M. P. Hobson, and S. J. Bence, Mathematical Methods for Physics and Engineering, 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

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	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:	Mathematical Physics Application
Course Code:	MTH2134
Program:	Physics
Department:	Mathematics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	12/1/2025

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 3/2 year)					
4. Course General Description:					
The course introduces application in mathematical physics that are relevant to physics and engineering. Emphasis is on the use of differential equations, probability, and mathematical tools of quantum mechanics.					
5. Pre-requirements for this course (if any)**:**					
Introduction to Mathematical Physics MTH1131					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course concentrates on essential mathematical methods application for solving advanced problems in theoretical physics. These application including differential equations, probability, and quantum mechanics operators.					

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	Recognize the basic concepts of probability.	K1	Lectures	Exams, homework and quizzes
1.2	Describe the basics mathematical tools of quantum mechanics.	K2	Lectures	Exams, homework and quizzes
1.3				
2.0	Skills			
2.1	Solve first and second order differential equations using different methods.	S2	Lectures	Exams, homework and quizzes
2.2				
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively individually or within a team	V1	Lectures	Exams, homework and quizzes
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Differential equation** • First-order differential equations • Separable variables • Exact equations • Integrating factors • Bernoulli's equation • Second-order equations with constant coefficients • Nature of the solution of linear equations • General solutions of the second-order equations • Finding the complementary function • Finding the particular integral • Particular integral and the operator D • Rules for D operators • The Euler linear equation • Solutions in power series • Ordinary and singular points of a differential equation • Frobenius and Fuchs theorem • Simultaneous equations	12
2.	**Probabilities and statistics** • Sample Space • Probability Theorems • Methods of Counting • Random Variables • Continuous Distributions • Binomial Distribution • The Normal or Gaussian Distribution • The Poisson Distribution • Statistics and Experimental Measurements	12
3.	**Operators** • Operator formalism • Operator Algebra • Commutators • Examples of operators • Solved examples	6
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exams	8th week	30%
2.	Homeworks and Quizzes	During the semester	20%
3.	Final Exam	End of the semester	50%
4.			

*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	Mathematical Methods for Physicists: A Concise Introduction, by T. Chow, Cambridge University Press; 1st edition (July 31, 2000). ISBN-13 : 978-0521655446. 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.
Supportive References	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.
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 • 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 (direct)

Assessment Areas/Issues	Assessor	Assessment Methods
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

Course Specification
(Bachelor)

Course Title:	Advanced classical Mechanics
Course Code:	PHYS2502
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

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 4/2nd Year)					
4. Course General Description:					
The course covers the study of the mechanics of rigid bodies in plane motion, in three dimensions, and their applications. Moreover, the course covers the Lagragnagian mechanics as well as a discussion of Hamilton's equations and their applications in solving some mechanical problems.					
5. Pre-requirements for this course (if any)**:**					
Classical Mechanics (PHYS2501)					
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. Center of mass of a rigid body. 2. Moment of inertia of a rigid body that rotated about a fixed axis. 3. Static equilibrium of rigid body. 4. Euler's equation of motion of a rigid body. 5. Lagrangian and Hamiltonian mechanics.					

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**			
1.1	Define the moment of inertia of a body.	K1	Lectures.	Exams, Quizzes, Homework.
2.0	**Skills**			
2.1	Apply Lagrangian and Hamiltonian mechanics to solve problems.	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Calculate the center of mass of a rigid body.	S2		
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				

C. Course Content

No	List of Topics	Contact Hours

1.	**Mechanics of Rigid Bodies, Planar Motion** • Center of mass of a rigid body. • Some theorems of static equilibrium of rigid body. • Rotation of a rigid body about a fixed axis (moment of inertia). • Calculation of the moment of inertia. • The physical pendulum. • General theorem concerning angular momentum. • Laminar motion of rigid body.	**15**
2.	**Motion of Rigid Bodies in Three Dimensions** • Angular momentum of a rigid body, Products of inertia. • Use of matrices in rigid body dynamics (the inertia tensor). • Determination of principle axes. • Rotational kinetic energy of a rigid body. • Moment of inertia of a rigid body about an arbitrary axis, the momental ellipsoid. • Euler's equation of motion of a rigid body. • Free rotation of a rigid body under no forces. Geometric description of the motion. • Free rotation of a rigid body with an axis of symmetry. Analytical treatment.	**18**
3	**Lagrangian Mechanics** • Generalized coordinates. • Generalized forces. • Lagrange's equations. • Some Applications of Lagrange's equations. • Generalized moments ignorable coordinate. • Lagrange's equations for impulsive forces. • Hamilton's variational principle. • The Hamiltonian function (Hamiltonian equation).	**12**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	**Analytical Mechanics by G. R. Fowles and G. L. Cassiday (2005), 7th edition.**
Supportive References	**Classical Mechanics by John R. Taylor (2005).**
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 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
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2024
TP-153

Course Specification
(Bachelor)

Course Title:	Modern physics
Course Code:	PHY2401
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4hrs)					
2. Course type					
A.	☐ University	☐ College	☒ Department	☐ Track	☐ Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (Level 4/ 2nd years)					
4. Course General Description:					
The course will cover the principle 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.** Many-Electrons Atoms **6.** Molecules **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	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		

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 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.	**8**
2.	**Particle Properties of Waves** ● Electromagnetic Waves, ● Blackbody Radiation, ● The photoelectric effect, ● XRays, X-Ray Diffraction, ● Compton Effect, ● Pair Production and Photons and Gravity.	**7**
3	**Wave Properties of Particles** ● De Broglie waves, ● Describing a Wave, Phase and Group Velocities, ● Particle Diffraction, ● Particle in a Box, ● Uncertainty Principle.	**7**
4	**Atomic Structure** ● The Nuclear Atom, ● Electron Orbits, Atomic Spectra, ● Bohr Atom, Energy Levels and Spectra, Correspondence Principle, ● Nuclear Motion, ● Atomic Excitation and The Laser	**8**

5	**Many-Electrons Atoms** • Electron Spin • Exclusive principle, symmetric and antisymmetric wave functions • Periodic Table, Atomic Structure • Spin-Orbit Coupling • Total Angular Momentum.	**7**
6	**Molecules** • The Molecular Bond, • Electron Sharing, • The H^{2+} Molecular Ion, • The Hydrogen Molecule, • Complex Molecules, • Rotational Energy Levels, • Vibrational Energy Levels, and • Electronic Spectra of Molecules.	**8**
7	**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)	8^{th} week (or 5^{th} and 10^{th})	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 (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

Course Specification
(Bachelor)

Course Title:	Theoretical Physics
Course Code:	PHYS2201
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	5/1/2025

Table of Contents

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 4/2 year)					
4. Course General Description:					
This course will provide a deep integration of conceptual and math from the physicists' point of view. It will help students to use theoretical tools to deeply understand the real world and its natural laws.					
5. Pre-requirements for this course (if any)**:**					
Heat and Waves PHYS2103					
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. Vector analysis. 2. Fourier series. 3. Integral transforms. 4. Ordinary differential equations.					

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**	60
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
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	Define vector fields (gradient, divergence, Curl)	K1	Lectures	Exams, homework and quizzes
1.2	Demonstrate Fourier series associated with simple functions and apply them to selected physical problems.	K2	Lectures	Exams, homework and quizzes
1.3				
2.0	**Skills**			
2.1	Solve differential equations using the method of separation of variables and Laplace transforms.	S1	Lectures	Exams, homework and quizzes
2.3	Apply Fourier and Laplace transforms to solve physics	S2	Lectures	Exams, homework and quizzes

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	problems.			
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	Vector analysis application • Applications of vector multiplication • Triple products • Differentiation of vectors • Fields • Directional derivative; gradient • Some other expressions involving ∇ • Line integrals • Green's theorem in the plane • The divergence and the divergence theorem • The curl and stokes' theorem	14
2.	Fourier series and transforms • Simple harmonic motion and wave motion; periodic functions • Applications of fourier series • Average value of a function • Fourier coefficients • Dirichlet conditions • Complex form of fourier series • Other intervals • Even and odd functions • An application to sound • Parseval's theorem • Fourier transforms	14
3.	Integral transforms • Development of the fourier integral	12

	• Fourier transforms—inversion theorem • Fourier transform of derivatives • Convolution theorem • Momentum representation • Transfer functions • Laplace transforms • Laplace transform of derivatives • Other properties • Convolution (faltungs) theorem • Inverse laplace transform	
4.	Ordinary differential equations • Separable equations • Linear first-order equations • Other methods for first-order equations • Second-order linear equations with constant coefficients and zero right-hand side • Second-order linear equations with constant coefficients and right-hand side not zero • Other second-order equations • The laplace transform • Solution of differential equations by laplace transforms • Convolution • The dirac delta function	20
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• 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.)	• 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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Education & Training Evaluation Commission
اعتماد
NCAAA
2024
TP-153

Course Specification
(Bachelor)

Course Title:	Advanced Mathematical Physics
Course Code:	MTH2133
Program:	Physics
Department:	Mathematics
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. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 4/2 year)					
4. Course General Description:					
This course is intended to introduce students to advanced level of mathematics which is need it in advanced physical problem.					
5. Pre-requirements for this course (if any)**:**					
Intermediate Mathematical Physics MTH2132					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course present some topics and methods of advanced mathematics that are relevant to physics and engineering. These methods including : group theory, tensors, complex variable, 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 • 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	Identify tensors to generalize scalars, vectors and matrices to higher dimensions.	K1	Lectures	Exams, homework and quizzes
1.2	Recognize the suitable method for Interpolation and Curve fitting.	K2	Lectures	Exams, homework and quizzes
...				
2.0	Skills			
2.1	Use concept of group theory to explain symmetry properties in physics.	S1	Lectures	Exams, homework and quizzes
2.2	Manipulate functions of complex variables	S2	Lectures	Exams, homework and quizzes
2.3	Apply the residual theorem.	S2	Lectures	Exams, homework and quizzes
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	Exams, homework and quizzes
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Curvilinear coordinates** • Orthogonal coordinates in r3 • Differential vector operators • Special coordinate systems • Circular cylinder coordinates • Spherical polar coordinates	6
2.	**Group theory** • Introduction to group theory • Generators of continuous groups • Homogeneous lorentz group • Lorentz covariance of maxwell's equations • Discrete groups • Differential forms	9
3.	**Tensor analysis** • Cartesian tensors • Tensor notation and operations • Inertia tensor • Kronecker delta and levi-civita symbol • Pseudovectors and pseudotensors • More about applications • Curvilinear coordinates • Vector operators in orthogonal curvilinear coordinates • Non-cartesian tensors	9
4.	**Complex variables** • Functions of a complex variable • The cauchy–riemann relations • Power series in a complex variable • Some elementary functions • Multivalued functions and branch cuts • Singularities and zeros of complex functions	9

	• Conformal transformations • Complex integrals • Cauchy's theorem • Cauchy's integral formula • Taylor and laurent series • Residue theorem • Definite integrals using contour integration • Applications of complex variables • Complex potentials • Applications of conformal transformations • Location of zeros • Summation of series • Inverse laplace transform • Stokes' equation and airy integrals • Wkb methods	
5.	**Numerical methods** • Interpolation • Curve fitting • Examples	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	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 George B. Arfken, Hans J. Weber, Frank E. Harris , Mathematical Methods for Physicists: A Comprehensive Guide, 7th edition,

	Academic Press is an imprint of Elsevier (2013), ISBN-13: 978-0-12- 384654-9.
Supportive References	K. F. Riley, M. P. Hobson, and S. J. Bence, Mathematical Methods for Physics and Engineering, 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
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

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

Course Specification
(Bachelor)

Course Title:	Quantum Mechanics
Course Code:	PHYS3504
Program:	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: (4)					
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 comprehensive course covers the fundamental principles and mathematical formulations of quantum mechanics, transitioning from classical to quantum physics. Key topics include wave-particle duality, Heisenberg's uncertainty principle, probabilistic interpretation, Hilbert space, Dirac notation and operator algebra. Students explore one-dimensional (free particle, infinite square well, potential barrier) and three-dimensional quantum systems (central potential, hydrogen atom), angular momentum (orbital and spin) and the Schrödinger equation's role in describing quantum phenomena. Mathematical modeling, problem-solving and analytical techniques are emphasized throughout.					
5. Pre-requirements for this course (if any)**:**					
Modern Physics PHYS2401					
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. Principles of quantum physics 2. One-Dimensional Problems in quantum physics. 3. Three-Dimensional Problems in quantum physics. 4. Angular momentum in quantum mechanics.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	60	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**	60
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
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	Recall the limits of classical physics and State the postulates of quantum mechanics	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Identify operators, eigenvectors, and eigenvalues	K1		
1.3	Describe hydrogen atom energy levels	K3		
2.0	Skills			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Employ and interpret wavefunction to predict physical quantities.	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Derive Schrodinger equation based on free particle wavefunction.	S1		
2.3	Solve time-dependent and time-independent Schrodinger equations	S2		
2.4	for different potentials.	S2		
3.0	Values			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.

C. Course Content

No	List of Topics	Contact Hours
1.	**Origins of Quantum Physics and Limits of Classical Physics** 1. Particle Aspect of Radiation and Wave Aspect of Particles 2. Particles versus Waves, Wave–Particle Duality: Complementarity 3. Indeterministic Nature of the Microphysical World, Heisenberg's Uncertainty Principle 4. Probabilistic Interpretation	**8**

	5. Wave Packets, Motion of Wave Packets: Group and Phase Velocities	
2.	**Mathematical Tools of Quantum Mechanics** 1. The Hilbert Space and Wave Functions, Square-Integrable Functions 2. Dirac Notation 3. Operators, Commutator Algebra, Eigenvalues and Eigenvectors 4. Representation in Discrete and Continuous Bases 5. Matrix and Wave Mechanics	**10**
3.	**Postulates of Quantum Mechanics** 1. The Basic Postulates of Quantum Mechanics 2. Observables and Operators 3. Measurement in Quantum Mechanics: Expectation Value 4. Time Evolution of the System's State 5. Connecting Quantum to Classical Mechanics, The Ehrenfest Theorem	**10**
4.	**One-Dimensional Problems** 1. The Free Particle: Continuous States 2. The Infinite Square Well Potential 3. The Finite Square Well Potential 4. The Potential Barrier 5. The Harmonic Oscillator	**12**
5.	**Three-Dimensional Problems** 1. The Schrödinger Equation, The Central Potential 2. The Angular Equation, Spherical Harmonics 3. The Radial Equation 4. The Hydrogen atom; The Quantum Numbers n, l, m 5. The Energy Spectrum of Hydrogen	**10**
6.	**Angular momentum** 1. Orbital Angular Momentum 2. General Formalism of Angular Momentum 3. Matrix Representation of Angular 4. Spin Angular Momentum, Evidence 5. Eigenfunctions of Orbital Angular Momentum	**10**
Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
4.	Final Exam	End of semester	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. Zettili, N. Quantum Mechanics: Concepts and Applications, 3rd Edition (2022), John Wiley & Sons Inc. ISBN-10 : 1118307895, ISBN-13 : 978-1118307892 2. Griffiths, D. J. and Schroeter, D. F. Introduction to Quantum Mechanics, 3rd Edition (2018), Cambridge University Press, 2004. ISBN: 9781107189638.
Supportive References	1. R. Shankar, Principles of Quantum Mechanics, Plenum Press; 2nd edition (August 31, 1994). ISBN-13 : 978-0306447907. 2. David H. McIntyre, Quantum Mechanics A Paradigms Approach, Cambridge University Press. ISBN: 9781009310611.
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 • 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

Course Specification
(Bachelor)

Course Title:	Electrodynamics
Course Code:	PHYS3302
Program:	Physics
Department	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	10/3/2025

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: 3rd Year / Level 6					

4. Course General Description:

This course deals primarily with a vector analysis-based description of static electric field, electric flux, and electric potential for a distribution of charges, and application of Gauss's law. Also, the course covers the methods of solving electrostatic problems such as Laplace equation, and electrostatic images. The course will cover the problems of calculating the electric fields and electric potential inside and outside the dielectric materials as well as the molecular field, and electrostatic energy. The course deals with a vector analysis-based description of magnetic field, magnetic flux, and magnetic potential, and application of Gauss's law as well as the magnetic induction for a steady current circuit.

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

Theoretical Physics PHYS2**2**01

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. Vector Analysis in electrostatic.
2. Electrostatic force, fields, and potential.
3. The Electrostatic Field in Dielectric Media.
4. Microscopic Theory of Dielectrics.
5. Electrostatic Energy.
6. Electric Current.

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	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**	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 the physical quantities related to the static electricity.	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe the Microscopic Theory of Dielectrics	K2		
...				
2.0	Skills			
2.1	Solve problems of dielectric media.	S1	Lectures.	Exams, Quizzes,

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Solve problems related to electric current	S1		Homework.
2.3	Calculate the electrostatic energy.	S2		
...				
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Review on Vector Analysis** • Vector formulas. • Vector operations. • The line integral. • The surface integral. • The divergence theorem. • Stokes' theorem. • Cartesian, spherical, and cylindrical Coordinates	6
2.	**Electrostatics** • Electric charge. • Coulomb's law. • The electric field. • Electrostatic potential. • Conductors & insulators. • Gauss's law. • The electric dipole	9
3.	**Solution of electrostatic problems** • Poisson's equation. • Laplace's equation. • Laplaces's equation in one independent variable. • Laplace's equation in spherical coordinates (harmonic zone). • Conducting sphere in uniform. • Electrostatic images.	6
4.	**The Electrostatic Field in Dielectric Media** • Polarization. • Field outside of a dielectric medium. • The electric field inside a dielectric. • The electric displacement. • Electric susceptibility and dielectric Constant. • Point charge in a dielectric field. • Boundary conditions on the field vector. • Boundary value problem involving dielectrics.	9
5.	**Microscopic Theory of Dielectrics** • Molecular field in a dielectric. • Induced dipoles. • Polar molecules. The Langevin-Debye formula. • Permanent polarization. Ferroelectricity	6
6.	**Electrostatic Energy**	6

	• Potential energy of a group of point charges. • Energy density of an electrostatic field. • Energy of a system of charged conductors. • Capacitors	
7.	**Electric Current** • Current density & equation of continuity • Ohm's law • Steady currents in continuous media • Microscopic theory of conduction	3
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8 th	30%
2.	Homework's & Quizzes & Reports	All weeks	20%
3.	Final exam	End of semester	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	• Foundations of Electromagnetic Theory by John R. Reitz, and Frederick J. Milford (1960). • Electromagnetic Field Theory, Bo Thidé, UPSILON Media, (2000).
Supportive References	• Introduction to Electrodynamics by David J. Griffiths, 4th edition. • Modern Electrodynamics by Andrew Zangwill, (2013). • Electromagnetic Fields by Roald K. Wangsness, 2nd edition • Electromagnetic Fields and Waves by Paul Lorrain, Dale R. Corson, Francois Lorrain [W. H. Freeman and Company, 1988] 3rd Edition
Electronic Materials	https://www.khanacademy.org/science/physics
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

Course Specification
(Bachelor)

Course Title:	Thermodynamics
Course Code:	PHYS3503
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	10/3/2025

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: (5th Level-3th year)					
4. Course General Description:					
This course presents the basic concepts of heat and its general principles and also introduces the Kinetic theory of gases and basic concepts related to that. Students will study the first law of thermodynamics, types of systems and thermodynamic processes and also understand the second law of thermodynamics, heat engines and pumps. This course will explain the concept of entropy, the change in entropy in reversible processes, and the third law of thermodynamics. Finally, it will introduce thermodynamics potentials, internal energy U, enthalpy (H), the free energy of Gibbs (G) and Helmholtz free energy (A), Maxwell relations and their application, Tds equations, Clausiuos Claperyron equation.					
5. Pre-requirements for this course (if any)**:**					
Heat and Waves PHYS2103					
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. Thermal properties of matter 2. Thermodynamics properties. 3. First law of thermodynamics, Heat and Energy. 4. Second law of thermodynamics. 5. Entropy and third law of thermodynamics. 6. Thermodynamics potentials.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	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**	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	Outline the basic principles In thermodynamics	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe themodynamics processes.	K2		
1.3				
2.0	Skills			
2.1	Solve problems using suitable laws to calculate some parameters like entropy and its implications on thermo-dynamical variables.	S1	Lectures.	Exams, Quizzes, Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Explain Maxwell, TdS equations for thermo-dynamic and some Cycles and their efficiencies.	S2		
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.

C. Course Content

No	List of Topics	Contact Hours
1.	**Thermal properties of matter** Temperature and Heat, Temperature scales, Type of thermometer, Zero law of Thermodynamic, Thermal transfers, thermal expansion	8
2.	**Thermodynamics properties** Equation of ideal gas, Kinetic theory, Van der Waal equation for real gas, Dedication of the critical constant of a real gas of Van der Waal, Virial equation of state, Reduced equation of state, Adiabatic compressibility, P-V-T relationship of real gases, Phase Diagram.	8
3.	**First law of thermodynamics, Heat and Energy**: The types of systems and the processing in thermodynamics, The definition of heat capacity and specific heat capacity, Latent heat, Apply the first law of thermodynamics to evaluate the temperature and work and the internal energy and energy conversion, Explain the enthalpy, The relationship between specific heat for gas, The work done in an adiabatic process.	8
4.	**Second law of thermodynamics** Heat engines, refrigerators, Heat pumps, Reversible processes, Statements of Kelvin-Planck and Clausius. Carnot machine and its efficiency, and Examine the principles of the Carnot cycle and Efficiency of the Otto cycle and Diesel fuel and gasoline.	7
5.	**Entropy and third law of thermodynamics** The concept of entropy, Entropy in the reversible processes, The third law of thermodynamics.	7
6.	**Thermodynamics potentials**	7

	Thermodynamics potentials, Internal energy U, Enthalpy (H), The free energy of Gibbs (G) and Helmholtz free energy (A), Maxwell relations and their Application, TdS equations, Clausius Clapeyron equation.	

Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• Daniel V. Shroeder, An Introduction to Thermal Physics, Addison-Wesley Publishing Company, San Francisco, CA, 1999, The ISBN is 0-201-38027-7. • Thermodynamics: An Engineering Approach, Mehmet Kanoglu Yunus A. Cengel, Michael A. Boles, Mcgraw Hill Education, 10th edition, (2023)
Supportive References	• Yunus A. Cengel, Michael A. Boles and Mehmet Kanoglu, Thermodynamics, an Engineering Approach, McGraw – Hill, Inc., 2015. • Serway R. A, and Jewett J.W., Physics for Scientists and Engineers, 6th Edn., Thomson 2004, ISBN 053440.
Electronic Materials	• Websites, electronic library, X, .. etc
Other Learning Materials	

2. Required Facilities and equipment

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

Items	Resources
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

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

Course Specification
(Bachelor)

Course Title:	Optics
Course Code:	PHYS3402
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm-Al Qura University
Version:	47
Last Revision Date:	5/1/2025

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (4 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)**:**					
Modern Physics PHYS2401					
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.** Aberrations. **2.** Interference of light. **3.** Fourier analysis for physical optics. **4.** Diffraction of light. **5.** Fourier optics. **6.** Polaritzation **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		
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	Describe the type of aberrations.	K1	Lectures and lab experiments	Exams, homework, quizzes and lab reports
1.2	Define the interference of light	K2		
2.0	Skills			
2.1	Apply Fourier analysis for physical optics.	S1	Lectures and lab experiments	Exams, homework,

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Solve problems related to diffraction of light.	S2		quizzes and lab reports
2.3	Analyze interference, diffraction, polarization of light theoretically and experimentally	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.	Aberrations Types of aberrations and correction of aberrations	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	9
3.	Fourier analysis for physical optics 1- Fraunhofer diffraction 2- Fraunhofer diffraction by a single slit (by integration methods) 3- Diffraction maxima and half width for single slit 4- Fraunhofer diffraction by circular slit (by integration methods) 5- Airy disk and Rayleigh`s criterion 6- Fresnel diffraction and Fresnel integrals (by integration methods) 7- Cornu spiral, Fresnel diffraction on single slit.	9

	8- Huygens principle	
4.	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	6
5.	Fourier optics 1. Basic rules for Fourier transform. 2. Spatial filtering. 3. Diffraction theory of image formation in the microscope 4. Optical image processing.	6
6.	Polarization 1. Types of polarized light 2. Production of polarized 3. Optical active phenomena 4. Polarization caused by electric and magnetic fields	9
7.	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	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	• Introduction to Classical and Modern Optics, by Jurgen R. Meyer-Arendt, Prentic – Hall international , (1995). • Fundamentals of optics , by Francis Jenkins and Harvey White, Mc Graw Education, (2001)
Supportive References	• Modern Optics; Robert D. Guenther, John Wiley &Sons. Inc., 1990. • 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:	Advanced Theoretical Physics
Course Code:	PHYS3202
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura 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)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 5/3 year)					
4. Course General Description:					
This course builds upon theoretical physics, it will advance student knowledge about physical phenomena in the real world.					
5. Pre-requirements for this course (if any)**:**					
Theoretical Physics **PHYS2201**					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course covers special tools crucial for solving complex and advanced problems in physics. These techniques allow physicists to analyze complex problems in classical and quantum word.					

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**			
1.1	Identify mathematical model for many scientific and engineering problems involving partial differential equations.	K1	Lectures	Exams, homework and quizzes
...				
2.0	**Skills**			
2.1	Apply series solutions to solve differential equations in physical problems.	S1	Lectures	Exams, homework and quizzes
2.2	Use partial differential equations to model wave, heat flow and related phenomena.	S2	Lectures	Exams, homework and quizzes
2.3	Solve a variational problem by constructing an appropriate functional, and	S2	Lectures	Exams, homework and quizzes

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	solving the Euler Lagrange equations.			
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Series solutions of differential equations** • legendre, bessel, hermite, and laguerre functions • Legendre's equation • Leibniz' rule for differentiating products • Rodrigues' formula • Generating function for legendre polynomials • Complete sets of orthogonal functions • Orthogonality of the legendre polynomials • Normalization of the legendre polynomials • Legendre series • The associated legendre functions • Generalized power series or the method of frobenius • Bessel's equation • The second solution of bessel's equation • Graphs and zeros of bessel functions • Recursion relations • Differential equations with bessel function solutions • Other kinds of bessel functions • The lengthening pendulum • Orthogonality of bessel functions • Approximate formulas for bessel functions • Series solutions; fuchs's theorem • Hermite functions; laguerre functions; ladder operators	18
2.	**Partial differential equations**	18

	• Laplace's equation; steady-state temperature in a rectangular plate • The diffusion or heat flow equation; the schrödinger equation • The wave equation; the vibrating string • Steady-state temperature in a cylinder • Vibration of a circular membrane • Steady-state temperature in a sphere • Poisson's equation • Integral transform solutions of partial differential equations	
3.	**Calculus of variations** • The euler equation • Using the euler equation • The brachistochrone problem; cycloids • Several dependent variables; lagrange's equations • Isoperimetric problems • Variational notation	**9**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• 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.)	• 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

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

Course Specification
(Bachelor)

Course Title:	Advanced Quantum Mechanics
Course Code:	PHYS3505
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	1/1/2025

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)					
4. Course General Description:					
This quantum mechanics course explores fundamental concepts and mathematical formalisms. Topics include the addition of angular momenta, identical particles, approximation methods for stationary and time-dependent states, and scattering theory. Students will delve into perturbation theory, variational principles, transition probabilities, and interaction with radiation. Through mathematical derivations and applications, students will gain a deep understanding of quantum systems and prepare for advanced research in physics and related fields.					
5. Pre-requirements for this course (if any)**:**					
Quantum mechanics PHYS3504					
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. Angular Momenta in quantum physics 2. Identical Particles. 3. Approximation Methods for Stationary States. 4. Time-Dependent Perturbation Theory. 5. Scattering Theory					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	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**	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	Describe angular momentum coupling	K1	Lectures.	Exams, Quizzes, Homework.
1.2	recall symmetrization and Pauli's exclusion principle	K2		
1.3	describe the approximated methods in quantum mechanics	K2		
2.0	Skills			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Add two angular momenta and analyze many-particle quantum systems	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Solve problems using approximated methods	S2		
3.0	Values			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.

C. Course Content

No	List of Topics	Contact Hours
1.	**Addition of Angular Momenta** • Addition of Two Angular Momenta: General Formalism • Calculation of the Clebsch–Gordan Coefficients • Coupling (addition) of Two Spin Angular Momenta • Coupling (addition) of Orbital and Spin Angular Momenta	**6**
2.	**Identical Particles** • Many-Particle Systems: Schrödinger Equation, Interchange symmetry • Identical Particles in Classical and Quantum Mechanics • Exchange Degeneracy • Symmetrization Postulate, Symmetric and Antisymmetric Functions • The Pauli Exclusion Principle, Periodic Table of Chemical Elements	**9**
3.	**Approximation Methods for Stationary States** • Time-Independent Perturbation Theory a. Nondegenerate Perturbation b. Degenerate Perturbation Theory c. Fine Structure and the Anomalous Zeeman Effect • The Variational Principle	**9**

4.	**Time-Dependent Perturbation Theory** • General Formulation • Transition Probability • Transition Probability for a Constant Perturbation • Transition Probability for a Harmonic Perturbation • Application: Interaction of Atoms with Radiation a. Transition Rates for Absorption and Emission of Radiation b. Transition Rate within the Dipole Approximation c. The Electric Dipole Selection Rules	**12**
5.	**Scattering Theory** • Scattering and Cross Section • Scattering Amplitude of Spinless Particles • The Born Approximation • Partial Wave Analysis	**9**
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30%
2.	Homework's & Quizzes	All weeks	20%
4.	Final Exam	End of semester	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	• N. Zettili, Quantum Mechanics - Concepts and Applications, John Wiley & Sons Inc; 3rd edition (8 September 2022). ISBN-13: 978-1118307892. • David J. Griffiths and Darrell F. Schroeter, Introduction to Quantum Mechanics, Cambridge University Press; 3rd Revised edition (16 August 2018). ISBN-13 : 978-1107189638.
Supportive References	• R. Shankar, Principles of Quantum Mechanics, Plenum Press; 2nd edition (August 31, 1994). ISBN-13 : 978-0306447907.

	• David H. McIntyre, Quantum Mechanics A Paradigms Approach, Cambridge University Press. ISBN: 9781009310611.
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 • 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

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

Course Specification
(Bachelor)

Course Title:	Advanced Electrodynamics
Course Code:	PHYS3303
Program:	Physics
Department	Physics
College:	Science
Institution:	Umm Al-Qura 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)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: 4th Year / Level 7					
4. Course General Description:					
This course is extension of Electromagnetism 1. The course deals primarily with a vector analysis-based description of magnetic field, magnetic flux, and magnetic potential, and application of Gauss's law as well as the magnetic induction for a steady current circuit. The course will cover also, the magnetic properties of the materials, and the molecular field and the classification of the magnetic materials. The course will deal with magnetic energy of the magnetic materials.					
5. Pre-requirements for this course (if any):					
Electrodynamics PHYS3302					
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. The Magnetic Field of Steady Current. 2. The Electromagnetic Induction. 3. Magnetic Properties of Matter. 4. Microscopic Theory of The Magnetic Properties of Matter. 5. Magnetic Energy. 6. Maxwell's Equation's and Electromagnetic Waves.					

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	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	
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 the physical quantities related to the magnetic properties.	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe the phenomena of electromagnetic induction, and its application.	K2		
...				
2.0	Skills			
2.1	Solve physics problems related to the magnetic fields, and magnetic energy.	S1	Lectures.	Exams, Quizzes, Homework.
2.2	Apply Maxwell's equations to explain some phenomena.	S2		
...				
3.0	Values, autonomy, and responsibility			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.
3.2				
...				

C. Course Content

No	List of Topics	Contact Hours
1.	The Magnetic Field of Steady Current • Induction to magnetic field. • Lorentz force law and its applications. • Biot-Savart Law and its applications. • Ampere's Law. • Application of Ampere's law. • Divergence and curl of magnetic field. • The magnetic vector potential. • The magnetic scalar potential. The Magnetic flux	6
2	The Electromagnetic Induction • Self-inductance. • Mutual inductance. • The Neumann formula. • Inductances in series and parallel.	6
3	Magnetic Properties of Matter • The origin of magnetism in the matter. • Magnetic moment of the atom. • Magnetization. • Magnetic current density. • Surface current density. • Magnetic intensity. • Calculation of magnetic field of a magnetized object. • Magnetic susceptibility, Magnetic Permeability, and Hysteresis loop. • Classification of magnetic materials (diamagnetic materials, paramagnetic materials, and ferromagnetic materials). • Boundary condition of magnetic field. • Electric circuits containing magnetic media. • Magnetic circuits.	9
4	Microscopic Theory of The Magnetic Properties of Matter • Molecular field inside matter. • Origin of diamagnetism. • Origin of paramagnetism. • Theory of ferromagnetism. • Ferromagnetic domains. • Ferrites.	6
5	Magnetic Energy • Magnetic energy of a solid circuit. • Magnetic energy of coupled circuits. • Energy density in magnetic field. • Force and torques on rigid circuits.	6
6	Maxwell's Equation's and Electromagnetic Waves	12

	• Displacement Current • Maxwell's Equation's • Wave Equation for Electric and Magnetic Field • Plane Wave • Plane Waves in Isotropic Insulating Media • Transfer of Plane Waves in Conductor • Resistance of conductors at ultra high frequencies • Applications of Maxwell's Equations • Boundary Conditions • Refraction and Reflection at the boundary of two non-conducting media • Electromagnetic waves Energy • The Wave Equation with Sources	
Total		45

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	7-8 th	30%
2.	Homework's & Quizzes& Reports	All weeks	20%
3.	Final exam	End of semester	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	• Foundations of Electromagnetic Theory by Reitz, John R., Milford, Frederick J., Christy, Robert W. [Addison-Wesley, 2008] 4th Edition • Electromagnetic Fields and Waves by Paul Lorrain, Dale R. Corson, Francois Lorrain [W. H. Freeman and Company, 1988] 3rd Edition • Introduction to Electrodynamics by David J. Griffiths, [Prentice-Hall, Inc., 1999], 3rd Edition.
Supportive References	• I.S. Grant and W.R. Phillips, Electromagnetism, Second Edition, John Wiley & Sons, New York, 2008. • Elements of Electromagnetics : M. N. O. sadiku [Oxford University Press, 2001] 3rd Edition
Electronic Materials	• Web Sites, Social Media, Blackboard, Facebook, Twitter, etc.) • Consult courses in website of the certified universities. • www.youtube.com.

	• http://en.wikipedia.org/wiki/Electromagnetism
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

Course Specification
(Bachelor)

Course Title:	Solid State physics
Course Code:	PHYS3701
Program:	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)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (level 6 / year 3)					
4. Course General Description:					
This course is intended to introduce the physics of the solid state. It begins by the definition of the Solid State and Crystal Growth, Crystalline Amorphous and Nano solids, Atomic Binding, Crystal Lattices and structures, Miller indices Elastic Constants, Crystal Defects, Fourier Analysis of Periodic Structures, Reciprocal Lattice, X-ray Diffraction, Brillouin Zones, Lattice Vibrations and Phonons, Thermal properties of Solids, Einstein and Debye Models of Heat Capacity, Phonon Density of States, Planck Distribution. Free Electron (Fermi gas) model, Electron Density of States, Electrical, thermal and optical properties of the Electron Gas.					
5. Pre-requirements for this course (if any)**:**					
Quantum Mechanics PHYS3504					
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	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**	60
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
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	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,

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	solve problems related to semiconductor phenomena	S1		Quizzes
2.3	Apply concepts of physics to predict the energy bands structure of solids	S2		
...				
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** • Periodic Array of Atoms. • Fundamental Types of Lattices. • Index Systems for Crystal Planes • Simple Crystal Structure • Direct Imagining of Atomic Structure • Nonideal Crystal Structures	10
2.	**Wave Diffraction and the Reciprocal Lattice** • Diffraction of Waves by Crystals. • Scattered Wave Amplitude. • Brillouin Zones • Fourier Analysis of the Basis.	8
3.	**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
4.	**Phonons I. Crystal Vibrations**	7

	• Vibrations of Crystals with Monatomic Basis. • Two Atoms per Primitive Basis • Quantization of Elastic Waves. • Phonon Momentum. • Inelastic Scattering by Phonons.	
5.	**Phonons II. Termal Properties** • Phonon Heat Capacity • Anharamonic Crystal Interactions. • Thermal Conductivity.	7
6.	**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.	6
7.	**Band theory** • Energy spectra in atoms, molecules and solids. • Bloch theorem. • Brillouin zones. • Number of states in the band. • Nearly free electron model	4
8.	**Semiconductor** • Quantum Theory of Solids. • Semiconductor in Equilibrium. • Carrier Transport Phenomena. • The pn Junction.	12

Total		**60**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Midterm Exam	8^{th} week	30%
2.	HomeWorks & Quizzes	All weeks	20%
3.	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). • Solid State Physics, Ashcroft & Mermin, 1st Edition, Harcourt Asia Pte Ltd (1976).
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

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

Course Specification
(Bachelor)

Course Title:	Statistical Physics
Course Code:	PHYS3506
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura 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)					
2. Course type					
A.	☐ University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐ Elective		
3. Level/year at which this course is offered: (5th Level-3th year)					
4. Course General Description:					
The course will give the new mathematical treatment based on the concept of the probability and statistical mechanics to measure microscopic properties of the system to calculate the dependence of the macroscopic properties of a system on thermodynamic variables.					
5. Pre-requirements for this course (if any):					
Thermodynamics PHYS3503					
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. macroscopic and microscopic thermodynamic- energy levels and energy states - distinguishable and indistinguishable particles 2. Bose- Einstein, Fermi-Dirac and Maxwell Boltzmann statistics. 3. Applications of statistics to gases. 4. Applications of quantum statistics.					

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 basic principles in statistical thermodynamics	K1	Lectures.	Exams, Quizzes, Homework.
1.2	Describe the mathematical form for (Bose-Einstein, Fermi-Dirac, Maxwell-Boltzmann) statistics and distributions function and the conditions of applying each one.	K2		
...				
2.0	Skills			
2.1	Solve problems using suitable statistics to calculate some thermo-dynamical properties in	S1	Lectures.	Exams, Quizzes, Homework.

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	terms of partition function.			
2.2	Applly quantum statistics to quantized systems.	S2		
3.0	**Values, autonomy, and responsibility**			
3.1	Work individually or within a team in research projects with high professionalism.	V1	Lectures.	Exams, Quizzes, Homework.

C. Course Content

No	List of Topics	Contact Hours
1.	**Statistical thermodynamics** • Introduction • Energy States and energy levels • Macro states and microstates • Thermodynamic probability • The Bose-Einstein statistics • The Fermi-Dirac statistics • The Maxwell Boltzmann statistics • The statistical interpretation of entropy • The Bose-Einstein distribution function • The Fermi-Dirac distribution functions • The classical distribution function • comparison of distribution functions for indistinguishable particles • The Maxwell-Boltzmann distribution function • The partition function • Thermodynamic properties of a system	15
2.	**Applications of statistics to gases** • The monatomic ideal gas, • The distribution of molecular velocities • Experimental verification of the Maxwell-Boltzmann speed distribution- Molecular beams • Ideal gas in a gravitational field • The principle of equipartition of energy • The quantized linear oscillator	15

	• Specific heat capacity of a diatomic gas.	
3.	**Applications of quantum statistics to other systems** • The Einstein theory of the specific heat capacity of a solid • The Debye theory of the specific heat capacity of a solid • Black body radiation, • Para-magnetism • Negative temperatures • The electron gas.	15

Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8^{th}	30%
2.	Homework's & Quizzes	All weeks	20%
3.	Final Exam	End of semester	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	• Thermodynamics, Kinetic theory, and statistical thermodynamics, F.W. Sears and G.L. Salinger (1975).
Supportive References	• Introduction to statistical physics, k. Huang (2001). • Fundamentals of Statistical and Thermal Physics, R. Reif (2008).
Electronic Materials	• Websites, electronic library, X, .. etc
Other Learning Materials	

2. Required Facilities and equipment

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

Items	Resources
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

Course Specification
(Bachelor)

Course Title:	**Computational Physics**
Course Code:	**PHYS3203**
Program:	**BSc in Physics**
Department:	**Physics**
College:	**College of Science**
Institution:	**Umm Al-Qura University**
Version:	**47**
Last Revision Date:	**10/3/2025**

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 6/3rd Year.)					
4. Course General Description:					
Computational Physics course is designed to cover techniques on using numerical methods to model physical systems and analyze experimental data. It aims to provide students with practical experience in physics programming and various scientific software. It is important to note that this course is not centered on computer programming, but rather on applying programming skills to solve scientific problems in physics.					
5. Pre-requirements for this course (if any)**:**					
PHYS2201 Theoretical Physics					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
The main objective of this course is to introduce students to scientific computing in physics. Students will be introduced to computational methods used in solving many physical problems. These physical problems include mechanics, electromagnetism, quantum mechanics, and statistical mechanics. As the course progresses, students will develop their skills at numerical methods, solution visualization, and analyzing data. This course is based on python or any equivalent language.					

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		

No	Mode of Instruction	Contact Hours	Percentage
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	**Recognize key concepts and tools of numerical methods to solve different types of physics problems.**	**K1**	**Lectures**	**Exams, homework and quizzes**
2.0	**Skills**			
2.1	**Develop a code in a programming language to produce analytical solutions to basic mathematical problems.**	**S1**	**Lectures Practical work**	**Exams, lab homework and quizzes**
2.2	**Utilize coding techniques to carry out a programming project aimed at**	**S2**	**Lectures Practical work**	**Exams, lab homework and quizzes**

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
	stimulating physical phenomena.			
2.3	Perform simulations of physics phenomena using simulation packages.	S2,S3	Lectures Practical work	Exams, lab homework and quizzes
2.4	Employ simple library routines to solve advanced problems in physics.	S2	Lectures Practical work	Exams, lab homework and quizzes
2.5	Apply AI to solve practical problems in physics	S2	Lectures Practical work	Exams, lab homework and quizzes
3.0	**Values, autonomy, and responsibility**			
3.1	Work collaboratively and constructively within groups to manage projects.	V1	Practical work, Discussion	Evaluate the effort of each student in preparing reports.

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction To Python Programing** 1. Basic programming 2. Controlling programs with “if” and “while” 3. Lists and arrays 4. “For” loops 5. User-defined functions	**6**
2.	**Graphics And Visualization** 1. Graphs 2. Scatter plots 3. Density plots 4. 3D graphics	**4**
3.	**Integrals And Derivatives** 1. Fundamental methods for evaluating integrals 2. Derivatives	**2**
4.	**Solution Of Linear And Nonlinear Equations** 1. Simultaneous linear equations 2. Eigenvalues and eigenvectors 3. Nonlinear equations	**2**
5.	**Fourier Transforms** 1. Fourier series 2. The discrete Fourier transform 3. Discrete cosine and sine transforms 4. Fast Fourier transforms	**2**
6.	**Ordinary Differential Equations** 1. First-order differential equations with one variable 2. Differential equations with more than one variable 3. Second-order differential equations 4. Varying the step size 5. Other methods for differential equations 6. Boundary value problems	**4**
7.	**Partial Differential Equations** 1. Boundary value problems and the relaxation method 2. Faster methods for boundary value problems 3. Initial value problems	**2**
8.	**Data Fitting and Interpolation**	**4**
9.	**Artificial Intelligence AI** 1. Introduction to AI	**4**

	2. Machine Learning 3. Deep Learning 4. Application of AI	
	Practical Part : Modeling And Simulation Free Fall and Ordinary Differential Equations Realistic Projectile Motion with Air Resistance Planetary Motion and Few-Body Problems Oscillations and Waves Electromagnetic Fields Time-dependent Schrödinger equation Time-Independent Quantum Mechanics Solving Heat equation Poisson's Equation in Two Dimensions	**45**
Total		**75**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Homework and Quizzes	During the semester	10%
2.	Midterm Exams	7th week	20%
3.	Practical work	During the semester	20%
4.	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	1. Computational Physics by Mark Newman, Createspace Independent Publishing Platform; Standard Edition (7 November 2012). ISBN-13 : 978-1480145511. 2. Computational Modeling and Visualization of Physical Systems with Python, Jay Wang (2016) Wiley-VCH. ISBN: 978-1-119-17918-4. 3. Computational Physics: Problem Solving with Python, 4th Edition by Rubin H. Landau, Manuel J. Páez, Cristian C. Bordeianu, Blackwell Verlag GmbH; 3rd edition (22 July 2015). ISBN-13 : 978-3527413157. 4. Numerical Methods in Physics with Python by Alex Gezerlis, Cambridge University Press; 2nd ed. edition (30 April 2023). ISBN-13 : 978-1009303866. 5. Artificial Intelligence in Everyday Life Simplified: Unlock the Power of AI for Personal Growth, Efficiency, and Time Management

	by Linda Jreige, Independently published (June 18, 2024). ISBN-13 : 979-8328308137 6. Physics of Data Science and Machine Learning by Ijaz A. Rauf, CRC Pr I Llc; 1st edition (29 November 2021). ISBN-13 : 978-1032074016 7. Machine Learning for Physics and Astronomy, by Viviana Acquaviva, Princeton University Press (August 15, 2023). ISBN-13 : 978-0691206417
Supportive References	1. Numerical Method for Engineers, Steven C. Chapra & Raymond P. Canale, 7Th Edition. McGraw-Hill International Edition. ISBN: 978-9814670-87-6
Electronic Materials	https://www.python.org/ https://www.programiz.com/python-programming https://www.online-python.com/
Other Learning Materials	

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	**Classrooms** **Computer room** **Library**
Technology equipment (projector, smart board, software)	**Projector** **MATLAB, Castep material studio, Comsol Multiphysics.**
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.	
DATE	**XX/X/2025**

Field Experience Specification
(Bachelor)

Course Title:	**Co-op Training in Physics**
Course Code:	**PHYS7700**
Program:	**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 to calculate the physical quantity	S1	Training in the field	•Final report,	Advisors: 1-faculty member 2- Field member
2.2	Explain the scientific theoretical and empirical procedures in physics	S2			
...					
3.0	Values, autonomy, and responsibility				

Code	Learning Outcomes	Aligned PLO Code	Training Activities	Assessment Methods	Assessment Responsibility
3.1	Apply standards of integrity and ethics in all tasks	V1	Training in the field	•Progress report, •Final presentation	Advisors: 1-faculty member 2- Field member
3.2	Collaborate and contribute responsibly and effectively in teamwork	V1			
...					

*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.		

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

Course Specification
(Bachelor)

Course Title:	Advanced Solid State physics
Course Code:	PHYS4702
Program:	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)					
2. Course type					
A.	☐University	☐ College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 8/ 4th Year)					
4. Course General Description:					
Energy band theory, the nearly free electron model and effective mass concept, classification of materials according to energy band gap, conduction in intrinsic and extrinsic semiconductors, magnetic materials (paramagnetic, diamagnetic and ferromagnetic materials), theory of superconductivity, Meissner effect and Josephson effect					
5. Pre-requirements for this course (if any)**:**					
Solid State Physics PHYS3701					
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. Fermi Surface and Metals. 2. Diamagnetism and Paramagnetism. 3. Ferromagnetism and Antiferromagnetism. 4. Superconductivity. 5. Transport properties in Conductors and Semiconductors. 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		

No	Mode of Instruction	Contact Hours	Percentage
	• Traditional classroom • E-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 Fermi levels.	K1	Lectures and Lab experiments	Exams, Homework, Quizzes and Lab reports
1.2	Describe the magnetic properties of materials.	K2		
...				
2.0	**Skills**			
2.1	Solve propblems related to transport properties of materials	S1	Lectures and Lab experiments	Exams, Homework, Quizzes and Lab reports
2.2	Apply physics concepts to understand superdoncutivity phenomena..	S2		
2.3	Analyze the results of experiments	S3		

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 and Lab experiments	Exams, Homework, Quizzes and Lab reports
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Fermi Surface and Metals** • Construction of Fermi Surfaces. • Electron Orbits, Hole Orbits, and Open Orbits. • Calculation of Energy Bands	6
2.	**Diamagnetism and Paramagnetism** • Langevin Diamagnetism Equations • Quantum Theory of Diamagnetism of Mononuclear Systems. • Paramagnetism. • Quantum Theory of Paramagnetism. • Paramagnetic Susceptibility of Conduction Electrons.	6
3.	**Ferromagnetism and Antiferromagnetism** • Ferromagnetic Order. • Magnons • Neutron Magnetic Scattering. • Ferrimagnetic Order. • Antiferromagnetic Order. • Ferromagnetic Domains. • Single Domain Particles.	6
4.	**Superconductivity** • Zero resistance. • Perfect diamagnetism and Meissner effect. • The critical field. • Theory of superconductivity. • Josephson effect. • Applications of superconducting materials.	6
5.	**Transport properties in Conductors and Semiconductors** • Hall effect. • Quantum Hall effect. • Optical properties in solids. • Dielectric and Ferroelectrics	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**

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	• Elementary Solid state Physics, M A Omar, Addison – Wesley publishing company, USA (1993). • Solid State Physics, by R. K. Puri & V. K. Babbar 3rd Edition, Ram Nagar, New Delhi: S. Chand, (2008). • Introduction to Solid State Physics, Charles Kittle, John Wiley & Sons, Inc., New York, 1996.
Supportive References	
Electronic Materials	• http://www.crystallography.net/cod/result.php • http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html
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

Course Specification
(Bachelor)

Course Title:	Nuclear Physics
Course Code:	PHYS4601
Program:	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: (4)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		
3. Level/year at which this course is offered: (Level 8/4thYear)					
4. Course General Description:					
This course provides an in-depth exploration of nuclear physics, emphasizing the fundamental concepts and models that describe the properties and behavior of nuclei. Throughout the semester, students will engage with the phenomenology of the nucleus, learning about its size, structure, stability, and the forces that govern its behavior. The course begins with introductory remarks that set the stage for understanding the significance of nuclear physics in various scientific and technological domains. Students will delve into the classification and properties of nuclei, including nuclear spins, dipole moments, and the quantum mechanical principles that govern nuclear stability and instability. The course thoroughly examines the nuclear models that physicists use to describe these phenomena, such as the Liquid Drop Model, which considers the nucleus analogously to a macroscopic liquid drop, and the Fermi-Gas Model, which views nucleons as particles in a Fermi gas. Further exploration in the Shell Model will illustrate how quantum mechanics shapes our understanding of nuclear energy levels and interactions, including the essential concepts of spin-orbit coupling and the predictive power of the model regarding nuclear structure and reactions. Radiative aspects of nuclear physics, including alpha, beta, and gamma decay, are covered in detail, providing insights into the mechanisms of nuclear transformations and the fundamental forces involved, notably the weak interaction. The course will equip students with a comprehensive understanding of the theoretical and practical aspects of nuclear physics, preparing them for advanced studies or careers in physics, engineering, and related fields. Lectures, problem-solving sessions, and discussions will be used to foster a deep understanding of each topic, ensuring that students are not only able to grasp theoretical concepts but also apply them to real-world problems and current research in nuclear physics. The course is designed for students who have a solid foundation in basic physics and a keen interest in advancing their knowledge to more complex and specialized topics in the field of nuclear physics.					
5. Pre-requirements for this course (if any)**:**					
Quantum Mechanics PHYS3504					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					

Course Objectives: Nuclear Physics

1. Understand Fundamental Nuclear Concepts: To provide students with a solid foundation in the basic concepts of nuclear physics, including the properties of nuclei, nuclear forces, and interactions.
2. Explore Nuclear Models: To familiarize students with various nuclear models such as the Liquid Drop Model, Fermi-Gas Model, and the Shell Model. The objective is to understand how these models explain different nuclear phenomena and predict nuclear behavior.
3. Analyze Nuclear Stability and Reactions: To enable students to understand and calculate the factors influencing nuclear stability and the processes involved in nuclear decay and reactions, including alpha, beta, and gamma decay.
4. Apply Quantum Mechanics to Nuclear Physics: To apply quantum mechanical principles to explain nuclear structure and phenomena, particularly focusing on aspects such as spin-orbit coupling and energy quantization within the context of the Shell Model.
5. Study Radiative Decay and Nuclear Forces: To provide comprehensive knowledge on the mechanisms of radiative decay and the theoretical underpinnings of the forces involved, including detailed studies on the weak interaction and electromagnetic processes in nuclei.
6. Develop Problem-Solving Skills: To enhance students' ability to apply theoretical knowledge to solve complex problems in nuclear physics, fostering critical thinking and analytical skills.
7. Prepare for Advanced Studies: To prepare students for further academic pursuits in nuclear physics or related fields by providing them with a robust understanding of both theoretical and practical aspects of the subject.
8. Encourage Scientific Inquiry: To stimulate curiosity and scientific inquiry, encouraging students to engage with current research and developments in nuclear physics.

These objectives are designed to ensure that upon completion of the course, students not only understand the theoretical aspects of nuclear physics but are also equipped with practical skills and critical thinking abilities to apply this knowledge effectively in academic or professional 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	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	Identify the fundamental principles and models of nuclear physics.	K1	Lectures, readings, and multimedia presentations	Exams, homework and quizzes
1.2	Describe the mechanisms of nuclear stability and decay processes.	K2	Lectures, group discussions, case studies	Exams, homework and quizzes
1.3	Comprehend the applications of quantum mechanics in nuclear physics.	K3	Interactive problem-solving sessions	Exams, homework and quizzes
2.0	**Skills**			
2.1	Analyze and solve complex problems related to nuclear reactions and decays.	S1	Lectures, Problem-solving sessions, practical labs	Exams, homework and quizzes, Practical work
2.2	Apply mathematical and computational techniques to model nuclear phenomena.	S2		
2.3	Develop experimental skills through lab experiments and simulations.	S3	Laboratory experiments, demonstrations	Lab reports
3.0	**Values, autonomy, and responsibility**			
3.1	Work effectively with responsibility in teamwork	V1	lab experiment	Lab reports

C. Course Content

No	List of Topics	Contact Hours
1.	**Introductory Remarks to Nuclear Phenomenology** - Overview of nuclear physics, significance in science and technology.	3
2.	**Properties of Nuclei: Labeling and Masses** - Discussion on nuclear notation, magic numbers, isotopes, isotones and isobars, nuclear masses and binding energy concepts.	3
3.	**Sizes of Nuclei, Nuclear Spins and Dipole Moments** - Examination of nuclear sizes, charge radii, nuclear spin, magnetic and electric dipole moments.	3
4.	**Stability and Instability of Nuclei** - Analysis of nuclear stability, decay modes, beta stability line, and neutron-proton ratio.	3
5.	**Nature of the Nuclear Force** - Exploration of the nuclear force characteristics, range, and the Yukawa potential.	3
6.	**Introductory Remarks to Nuclear Models** - Introduction to nuclear models, historical context, and their importance.	3
7.	**Liquid Drop Model** - Detailed study on the macroscopic model of nucleus, liquid drop analogy, surface tension, and semi-empirical mass formula.	3
8.	**Fermi-Gas Model** - Analysis of the microscopic view of nucleons as a Fermi gas, Pauli exclusion principle, and energy states.	3
9.	**Shell Model: Infinite Square Well** - Introduction to quantum mechanical models, potential well theory, quantized energy levels.	3
10.	**Shell Model: Harmonic Oscillator** - Discussion on harmonic oscillator potential in nuclear context, quantization, and its applications in nuclear structure.	3
11.	**Shell Model: Spin-Orbit Potential** - Exploration of spin-orbit coupling, its origin, and implications for nuclear shell structure.	3
12.	**Predictions of the Shell Model and Collective Model** - Comprehensive review of shell model predictions, magic numbers, and introduction to collective excitations in nuclei.	3
13	**Nuclear Radiation: Alpha Decay, Barrier Penetration** - Overview of alpha decay, concepts of barrier penetration.	3
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.	3
15.	**Gamma Decay** - Study of gamma decay, electromagnetic radiation from the nucleus, multipolarity, and selection rules.	3
16.	**Practical Part:**	45

	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.	
Total		**90**

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	5th - 10th 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	• "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. • "Modern Nuclear Physics" *Authors:* Alexandre Obertelli and Gabriel Martínez-Pinedo, *Edition:* 1st Edition, *Year:* 2021 *ISBN:* 978-3030308830 • "Fundamentals of Nuclear Physics" *Author:* Noboru Takigawa and Koji Yoshida, *Edition:* 1st Edition, *Year:* 2017 *ISBN:* 978-4431564578 • Krane, K.S., "Introductory Nuclear Physics", 3rd Edition, John Wiley and Sons Inc., India, 2008. ISBN: 978-0471805533
Supportive References	• Walter D. Loveland, David J. Morrissey, Glenn T. Seaborg. "Modern Nuclear Chemistry", 2nd Edition, 2006, John Wiley & Sons, Inc. ISBN: 978-0471115328 • 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)	• Projector and Smart Board: For presenting derivations, diagrams, and visual simulations of quantum field interactions.
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:	Electronics
Course Code:	PHYS4703
Program:	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)					
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 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)**:**					
Solid State Physics PHYS3701					
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	-	-
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	Defined electronic device.	K1	Lectures and 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 Lab reports
2.2	Explain the signal treatment in electronic device.	S2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
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 ● MOSFET Characteristics and parameters, FET Amplifiers	4
8.	Power Amplifiers ● Class A Power Amplifiers	4

	• Class B and Class AB Push-Pull Amplifiers • Class C Amplifiers	
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

Course Specification
(Bachelor)

Course Title:	Graduation Project
Course Code:	PHYS4801
Program:	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)					
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 physics, introduction to research methods, seminar discussions dealing with special physics topics of current interest. Planning, design, construction and management of physics project. 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 student 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 falsifiable a 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 the 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

Items	Resources
Technology equipment (projector, smart board, software)	• Software • Blackboard • 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:	Introduction to Medical Physics
Course Code:	PHYS4605
Program:	Physics
Department:	Physics
College:	Sciences
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: (2)					
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 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)**:**					
Modern Physics PHYS2401					
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 and its application in medicine: 1. Static force. 2. Elasticity and Strength of Materials. 3. The Motion of Fluids. 4. Waves and Sound. 5. Electricity. 6. Optics. 7. Atomic Physics. 8. Nuclear Physics.					

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 elementary medical physics	K1	Lectures	Exams, Homework, Quizzes
1.2	Describe the application of physics in medicine	K2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.0	**Skills**			
2.1	Solve problems in medical physics using suitable mathematical principles	S1	Lectures	Exams, Homework, Quizzes
2.2	Apply the laws of medical physics.	S2		
3.0	**Values**			
3.1	Work effectively individually or within a team	V1	Lectures	Exams, Homework, Quizzes

Course Content

No	List of Topics	Contact Hours
1.	**Static force** • Equilibrium and Stability • Equilibrium Considerations for the Human Body • Stability of the Human Body under the Action of an External Force • Skeletal Muscles • Levers • The Elbow • Friction Standing at an Incline	4
2.	**Elasticity and Strength of Materials** • Longitudinal Stretch and Compression • A Spring • Bone Fracture: Energy Considerations • Impulsive Forces • Fracture Due to a Fall: Impulsive Force Considerations • Airbags: Inflating Collision Protection Devices • Whiplash Injury • Falling from Great Height • Osteoarthritis and Exercise.	4
3.	**The Motion of Fluids**	4

	• Bernoulli's Equation • Viscosity and Poiseuille's Law • Turbulent Flow • Circulation of the Blood • Blood Pressure • Control of Blood Flow • Energetics of Blood Flow • Turbulence in the Blood • Arteriosclerosis and Blood Flow • Power Produced by the Heart • Measurement of Blood Pressure	
4.	**Waves and Sound** • Properties of Sound • Some Properties of Waves (Reflection, Refraction, Interference, Diffraction) • Hearing and the Ear (Performance, Frequency and Intensity and Loudness) • Bats and Echoes • Sounds Produced by Animals • Acoustic Traps • Clinical Uses of Sound • Ultrasonic Waves	4
5.	**Electricity** • The Nervous System • The Neuron • Electrical Potentials in the Axon • Action Potential • Axon as an Electric Cable • Propagation of the Action Potential • Synaptic Transmission. • Action Potentials in Muscles • Surface Potentials • Electricity in Plants • Electricity in the Bone	4
6.	**Optics** • Vision. • Nature of Light • Structure of the Eye • Accommodation • Eye and the Camera	4

	• Lens System of the Eye • Reduced Eye . • Retina • Resolving Power of the Eye. • Threshold of Vision • Vision and the Nervous System. • Defects in Vision. • Lens for Myopia. • Lens for Presbyopia and Hyperopia • Fiber Optics	
7	**Atomic Physics** • The Atom • Spectroscopy • Quantum • Electron Microscope • X-rays • X-ray Computerized Tomography	2
8	**Nuclear Physics** • The Nucleus • Magnetic Resonance Imaging • Nuclear Magnetic Resonance • Imaging with NMR • Functional Magnetic Resonance Imaging (fMRI) • Radiation Therapy • Food Preservation by Radiation • Isotopic Tracers • Laws of Physics and Life Exercises	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	8th week	30%
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	• Paul Davidovits "Physics in Biology and Medicine" 3rd edi. Elsevier 2008. • Russell K. Hobbie & Bradley J. Roth "Intermediate Physics for Medicine and Biology" Springer Science 2007.
Supportive References	• 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 • 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.)	• Classroom • Library
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

Course Specification
(Bachelor)

Course Title:	Renewable Energy
Course Code:	PHYS4705
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	10/3/2025.

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: (……)					
4. Course General Description:					
The main purpose of this course is to introduce students to the main renewable energy resources. Advantages, disadvantages and current challenges of these energy resources are covered in this course.					
5. Pre-requirements for this course (if any)**:**					
Solid State Physics PHYS3701					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course discusses the world's present needs of energy and future demands, as well as the limitations and issues of natural resources. It gives an overview of the main scientific principles and technologies related to harnessing and conversion of renewable energy resources, such as solar, wind, hydroelectric. Also, energy storge technology is covered in this course.					

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	Describe the fundamentals and principles of renewable energies and its application.	K1	Lectures	Exams, Homework, Quizzes
1.2	Differentiate between different types of renewable energies.	K2		
...				
2.0	**Skills**			
2.1	Apply mathematical techniques to solve complex problems	S2	Lectures	Exams, Homework, Quizzes
2.2	Relate the physics of renewables to real-world energy problems	S1		
2.3	Analyze data and calculation results	S3		
3.0	**Values, autonomy, and responsibility**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
3.1	Collaborate effectively within teams	V1	Lectures	Exams, Homework, Quizzes
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Introduction** World energy current status Climate change Energy challenges	4
2.	**Solar energy** Semiconductors: The band structure of crystalline solids, Intrinsic and extrinsic semiconductors, the p–n junction, The current–voltage characteristic of a p–n junction, Photon absorption at a p–n junction, Power generation by a solar cell, The Shockley–Queisser limit, Increasing the efficiency of solar cells, examples of solar cells from each generation such as CPV and perovskite-based devices	8
3.	**Wind energy** A brief history of wind power, Origin and directions of the wind, The Coriolis force, The flow of ideal fluids, The continuity equation, Bernoulli's equation, Extraction of wind power by a turbine, The Betz criterion	6
4.	**Hydropower** Hydroelectric power, The hydroelectric plant and its principles of operation, Flow of a viscous fluid in a pipe, Hydroelectric turbines, Wave power and motion, Water waves, Wave energy converters, Tidal power	6
5.	**Energy storage** Types of energy storage, Chemical energy storage, Biological energy storage, Hydrogen energy storage, Thermal energy storage, Mechanical energy storage Capacitors and supercapacitors, Rechargeable batteries, Fuel cells	4
6	**Emerging innovations in renewable energy** General survey of the latest innovations in the field of renewables, most recent environmental technologies related to renewables, emerging sustainable energy sources	2
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	8th week	30%
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	• Fundamentals of Renewable Energy Processes, by Da Rosa, Aldo Vieira and Ordonez, Juan Carlos. Publisher : Academic Press; 4th edition (April 2, 2021)
Supportive References	• Physics of energy sources, by King, George C. Publisher : Wiley; 1st edition (June 12, 2017)
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 • 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

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

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

Course Specification
(Bachelor)

Course Title:	Introduction to Nanotechnology
Course Code:	PHYS4706
Program:	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: (2)					
2. Course type					
A.	☐ University	☐College	☒ Department	☐Track	☐Others
B.	☐Required		☒ Elective		
3. Level/year at which this course is offered: (8th Level-4th year)					
4. Course General Description:					
This course focuses on the important areas of Nanotechnology. Students will understand the definition of Nanotechnology, synthetic methods, tools, and characterisation of nanomaterials and how their properties could affect their possible applications.					
5. Pre-requirements for this course (if any)**:**					
Solid State Physics PHYS3701					
6. Co-requisites for this course (if any)**:**					
7. Course Main Objective(s):					
This course combines knowledge of nanomaterials and nanotechnologies, including methods of synthesis and preparation, tools and characterisation, properties prepared nanomaterials, and linking them to their potential applications. It will enable students to achieve a distinct qualification. Furthermore, the course will provide students with a base for future research and study planning.					

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 meaning of the nanoscale and related quantum nature	K1	Lectures	Exams, Homework, Quizzes
1.2	describe the electronic and optical properties of nanomaterial and its applications in different fields	K2		
2.0	**Skills**			
2.1	Distinguish between zero, one and two nanostructures	S1	Lectures	Exams, Homework, Quizzes
2.2	Explain Synthetic methods of nanomaterials and its effect on their propreties	S2		
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.	**Big Picture and Principles of Small World** • Why One-Billionth of A Meter Is A Big Deal? • Thinking It Through: The Road Implications of Nanotechnology • Scaling Laws • Quantum Nature of Nano World	6
2.	**Nanomaterials** • Bonding Atoms To Make Molecules and Solids - Ionic Bonding - Covalent Bonding - Metalic Bonding - van der Waals Forces • Crystals and Small Structures - Wires - Films and layers - Porous Materials - Carbon Fullerens and Nanotubes • Methods of Synthesis - Top-Down Process - Bottom-Up Processes	6
3.	**Methods For Measuring Properties** • Introduction - Structure - Particle Size Determination • Microscopies - Scanning Electron Microscopy (SEM) - Transmission Electron Microscopy (TEM) - Tunneling Electron Microscopy (TEM) - Atomic Force Microscopy (AFM) • Spectroscopies - X-ray Spectroscopy - Raman Spectroscopy - Photoelectron Spectroscopy - UV-vis Spectroscopy	8
4.	**Properties and Applications of Semiconductors Nanostructures** • Electronic and Optical Properties • Nanomachines and Nanodevices: - Nanosensors - Imaging and display devices	6

	- Nanomaterials in Energy	
5.	**Issues in Nanomaterials** • Environment • Safety	**2**
6	**Application of nano technology** • Nanophotinic • Health and biophysics • Meta materials	**2**
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.			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	• Rogers, B. Nanotechnology: Understanding Small Systems. Jesse Adams, Nevada Nanotech Systems, Inc., Nevada, USA, Series: Mechanical Engineering Series. ISBN 10: 0849382076;
Supportive References	• Poole, C. P. and Owens, F. J. Introduction to Nanotechnology, John Wiley & Sons, Inc., Hoboken, New Jersey, 2003. • Kelsall, R. Nanoscale Science and Technology. Wiley.ISBN: 978-0-470-85086-2; 1sted. 2005.
Electronic Materials	• Websites, Electronic libraries, X, … etc
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

Course Specification
(Bachelor)

Course Title:	Nuclear Technology
Course Code:	PHYS4602
Program:	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: (2)					
2. Course type					
A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☐ Required		☒ Elective		
3. Level/year at which this course is offered: (Level 8/4thYear)					
4. Course General Description:					
This course, designed for B.Sc. Physics students, offers a comprehensive exploration of nuclear technology and its applications across various sectors. Over 15 weeks, students will delve into the fundamental principles and modern implementations of nuclear science, emphasizing both the theoretical underpinnings and practical applications in energy, medicine, industry, and environmental management. Objectives and Structure: The course begins with an introduction to the historical development of nuclear science, providing students with a foundation in basic nuclear terminology and an overview of how nuclear technologies are integrated into modern society. As the weeks progress, the course covers a broad spectrum of topics including the design and operation of different types of nuclear reactors, the principles of nuclear safety, the management of nuclear waste, and the critical role of nuclear technology in medical diagnostics and treatment. Specialized Focus: In addition to core topics, the course features elective modules in the latter weeks focusing on advanced areas such as Small Modular Reactors (SMRs), nuclear forensics, and the societal impacts and ethical considerations of nuclear technology. These electives allow students to tailor their learning experience according to their interests and career aspirations, encouraging deeper research and engagement with cutting-edge issues in nuclear technology. Practical and Interactive Learning: Instructional methods include lectures, guest presentations from experts in the field, lab sessions, and project-based learning. This mix ensures that students not only learn the theoretical aspects but also gain practical skills through hands-on experiments and real-world case studies. The course aims to foster critical thinking and problem-solving skills, preparing students for challenges they might face in the field of nuclear physics. Outcome: Upon completion of this course, students will be equipped with a robust understanding of nuclear technologies and their implications, enabling them to contribute effectively to industries and sectors that rely on nuclear science. They will also develop a keen awareness of the safety, environmental, and ethical dimensions of nuclear technology use. This course is ideal for students looking to broaden their knowledge in advanced physics and explore applications of nuclear science in practical and industrial contexts.					
5. Pre-requirements for this course (if any)**:**					
Nuclear Physics PHYS4602					
6. Co-requisites for this course (if any)**:**					

7. Course Main Objective(s):

The "Nuclear Technology" course is structured with the following key objectives to ensure students gain a comprehensive understanding of nuclear science and its applications:

1. Foundational Understanding of Nuclear Science: Equip students with a strong foundation in nuclear physics, including the history of nuclear technology development, fundamental principles, and basic terminology. This base knowledge is crucial for understanding more complex concepts discussed later in the course.
2. Comprehensive Knowledge of Nuclear Reactor Design and Operation: Teach students about the different types of nuclear reactors, including their components and functionalities. This includes an in-depth look at pressurized water reactors, boiling water reactors, and other reactor designs, along with the technological and operational nuances of each type.
3. Proficiency in Nuclear Safety and Waste Management: Instruct students on the principles of nuclear safety, including preventive measures, safety protocols, and emergency responses. Additionally, the course will cover effective strategies for the management and disposal of nuclear waste, incorporating lessons learned from past nuclear accidents.
4. Practical Applications in Medicine and Industry: Provide detailed insights into how nuclear technology is applied in fields such as medicine for diagnostics and treatment, and in industry for applications like material analysis and non-destructive testing. This objective is aimed at illustrating the broad utility of nuclear technology beyond power generation.
5. Understanding Environmental and Agricultural Applications: Explore the role of nuclear techniques in environmental conservation and agricultural improvement, such as through the use of isotopes in tracing environmental processes and managing soil and water resources.
6. Insights into Nuclear Security and Proliferation: Address issues related to nuclear security, including the prevention of nuclear proliferation. Students will learn about international treaties and safeguards that aim to secure nuclear materials and technology from misuse.
7. Exploration of Emerging Nuclear Technologies: Encourage students to engage with current trends and innovations in nuclear technology, such as small modular reactors and advances in nuclear fuel and waste recycling. This objective supports the preparation of students for future challenges and opportunities in nuclear technology.
8. Ethical Considerations and Societal Impacts: Foster critical thinking about the societal and ethical implications of nuclear technology, including public perception and the balance of risks and benefits. This component is crucial for developing responsible scientists who are aware of the broader impacts of their work in nuclear technology.

By the end of the course, students should be well-prepared to contribute effectively in various capacities within the nuclear science field, whether in research, operational, safety, or regulatory roles. They should also be able to critically evaluate the future developments and ethical considerations in the use of nuclear technology.

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	Understand the fundamental principles and historical development of nuclear technology.	K1	Lectures	Exams, Homework, Quizzes
1.2	Gain comprehensive knowledge of various nuclear reactor types and their operational mechanisms.	K2		
1.3	Master the principles of nuclear safety, waste management, and environmental impacts.	K3		
2.0	**Skills**			

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.1	Analyze nuclear reactor operations and safety protocols through simulations.	S1	Lectures	Exams, Homework, Quizzes
2.2	Apply theoretical knowledge to solve real-world problems related to nuclear technology applications in medicine and industry.	S2		
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	**Introduction to Nuclear Technologies** - Explore the milestones in the development of nuclear science, the role and impact of nuclear technology in contemporary society, and introduce basic nuclear terminology.	2
2	**Ion Sources and Accelerators** - Discuss different ion sources and their applications, detail the types and functions of accelerators (linear, cyclotrons, synchrotrons, rings), and analyze charged particle beam transport and radioactive ion beams.	2
3-4	**Nuclear Power Generation** - Cover the main components of a nuclear reactor, differentiate between types of reactors such as Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR), discuss the nuclear fuel cycle, and assess the advantages and challenges of nuclear power.	4
5-6	**Nuclear Safety and Waste Management** - Examine principles of nuclear safety, study major nuclear accidents (Chernobyl, Fukushima) and the lessons learned, and delve into methods and strategies for radioactive waste management and disposal.	4
7	**Applications of Nuclear Technology in Medicine** - Focus on the use of nuclear technology in diagnostic imaging (X-rays, CT scans, PET scans), radiation therapy for cancer treatment, and the development and use of radiopharmaceuticals.	2
8	**Industrial Applications of Nuclear Technology** - Discuss the use of nuclear techniques in non-destructive testing and material analysis, the role of	2

	radiation in sterilizing medical equipment, and the use of nuclear-powered systems in submarines and spacecraft.	
9	**Environmental and Agricultural Applications** - Explore the use of isotopes in environmental tracing and studies, the application of food irradiation for preservation, and the management of soil and water resources using nuclear techniques.	2
10	**Nuclear Security and Proliferation** - Discuss nuclear safeguards, international treaties aimed at preventing nuclear proliferation, the threats posed by nuclear proliferation, and the role of technology in ensuring nuclear security.	2
11	**Emerging Trends in Nuclear Technologies** - Introduce Small Modular Reactors (SMRs), discuss recent advancements in nuclear fuel and waste recycling, and highlight innovations in medical and industrial nuclear applications.	2
12	**Elective Topic 1: Advanced Reactor Design** - Detailed study of next-generation nuclear reactors, focusing on their design, technology, safety features, and potential impacts on the energy sector.	2
13	**Elective Topic 2: Nuclear Forensics** - Overview of nuclear forensic science, its methodologies, applications in national security, and its role in law enforcement and anti-terrorism efforts.	2
14	**Elective Topic 3: Societal Impacts and Ethical Considerations** - Examine public perceptions of nuclear technologies, explore ethical issues in nuclear research and applications, and discuss the balance between technological benefits and potential risks.	2
15	**Student Presentations/Reviews** - Students present projects or papers on chosen topics related to nuclear technology, integrating knowledge from the course, followed by peer reviews and discussions.	2
Total		**30**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Mid-term Exam	8th	30
2.	Homework's & Quizzes & project	All weeks	20
3.	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."Fundamentals of Nuclear Engineering" by Brent J. Lewis and E. Nihan Onder, Edition:** 1st Edition, **Publication Date:**

	March 31, 2017, **ISBN-10:** 1119271495, **ISBN-13:** 9781119271499 **2. Nuclear Reactor Physics" by Weston M. Stacey, Edition:** 3rd Edition (2018), **ISBN:** 9783527413331 **3."Radiation Detection and Measurement" by Glenn F. Knoll, Edition:** 4th Edition, **Publication Date:** 2010, **ISBN-13:** 9780470131480
Supportive References	• **Nuclear Systems: Thermal-Hydraulic Fundamentals Vol. I" by N E Duderstadt and M M Kazimi, Edition:** Latest available • **"Radiation Detection and Measurement" by Glenn F. Knoll Edition:** 4th Edition (2010) **ISBN:** 9780470131480
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.)	• Classroom • Library
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

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

Course Specification

(Postgraduate Programs)

Course Title:	**Radiation Physics**
Course Code:	PHY4603
Program:	**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: (2)				
2. Course type				
A.	☐ University	☐College	☒ Department	☐Track
B.	☐Required		☒ Elective	
3. Level/year at which this course is offered: (…….)				
4. Course General Description:				

This comprehensive course, designed for students in physics and related fields, delves into the fundamental aspects of radiation physics, providing a deep understanding of how radiation originates, interacts with matter, and its applications and implications in medical and environmental contexts. Over 15 weeks, students will explore a wide range of topics, from the basics of radioactivity and the mechanisms of radioactive transformations to the detailed interactions of various types of radiation with matter—such as alpha, beta, gamma rays, and neutrons. The course will guide students through the complex kinetics of radioactive decay, the principles and practices of radiation measurement, and the natural occurrence of radiation, emphasizing its relevance to public and occupational health. Special attention is given to the series transformations and equilibria that are crucial for handling and using radioactive materials safely. Furthermore, students will gain insight into radiation dosimetry, learning to quantify radiation absorption and its effects, with particular focus on both the deterministic and stochastic effects of radiation exposure. The course aims to equip students with the knowledge to navigate and apply radiation safety principles effectively, particularly in medical settings where radiation is used for diagnostics and treatment. Through lectures, laboratory sessions, and problem-solving exercises, the course not only enhances theoretical understanding but also emphasizes practical skills in handling radiation, understanding its effects on biological systems, and implementing safety measures to protect health. By the end of the course, students will be prepared to apply their knowledge in practical settings, conduct research, and contribute to advancements in radiation safety and medical physics. This curriculum is essential for those aiming to specialize in fields that require a thorough knowledge of radiation physics, such as radiology, nuclear medicine, and environmental health, ensuring they are well-prepared for professional challenges and innovations in these areas.

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

Nuclear Physics PHYS4601

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

7. Course Main Objective(s):

This course is structured to provide physics students with a comprehensive understanding of radiation physics, emphasizing theoretical knowledge, practical skills, and safety considerations. Here are the main objectives:

1. Understand the Fundamental Concepts of Radiation Physics: Students will learn the basic principles of radiation, including types of radiation (alpha, beta, gamma, and neutrons), sources of radiation, and the mechanisms of radioactive decay. This foundational knowledge is critical for further exploration and specialization in various fields of physics and related disciplines.
2. Analyze Radioactive Transformation and Kinetics: Students will develop a thorough understanding of transformation mechanisms, kinetics of radioactive decay, and the mathematical models used to describe these processes. This will enable them to predict the behavior of radioactive materials under various conditions.
3. Explore Radiation Interaction with Matter: The course will cover detailed interactions of different types of radiation with matter, such as absorption, scattering, and penetration. Understanding these interactions is essential for applications ranging from medical imaging to radiation shielding and safety.
4. Master Radiation Measurement and Dosimetry Techniques: Students will learn to measure radiation accurately using various detectors and to calculate the dose absorbed by different materials and biological tissues. These skills are vital for ensuring safe handling of radioactive materials and protecting public health.
5. Apply Knowledge to Radiation Safety and Biological Effects: The course will address the biological effects of radiation exposure, including both deterministic and stochastic effects. Students will learn about dose-response relationships and radiation protection standards to effectively manage and minimize risks in medical, industrial, and environmental settings.
6. Develop Practical Laboratory Skills: Through hands-on laboratory exercises, students will gain practical experience in handling radiation sources, measuring radiation levels, and applying safety protocols. This practical training is crucial for building competence in experimental techniques and safety practices in radiation physics.
7. Prepare for Advanced Studies and Research: Equip students with the theoretical and practical tools needed for advanced studies in radiation physics or related fields, such as medical physics, health physics, or nuclear engineering. The course will also lay the groundwork for students interested in conducting research in these areas.

These objectives are designed to ensure that students not only acquire a deep theoretical understanding of radiation physics but also develop the practical skills and safety awareness necessary for professional practice and research in this field.

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	Understand the fundamental physics of different types of radiation and their sources.	K1	Lectures	Exams, Homework, Quizzes
1.2	Gain deep knowledge of radioactive decay mechanisms and kinetics.	K2		

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
1.3	Comprehend the interactions of radiation with matter, including absorption and scattering processes.	K3		
2.0	**Skills**			
2.1	Apply techniques for measuring and analyzing radiation in practical settings.	S1	Lectures	Exams, Homework, Quizzes
2.2	Utilize mathematical and computational methods to model radiation interactions and safety measures.	S2		
2.3	Implement safety protocols and procedures for handling radioactive materials.	S3		
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.	**Introduction to Radioactivity and Transformation Mechanisms** - Overview of radioactivity, including alpha, beta, and gamma decay mechanisms. Explain the law of radioactive decay.	2
2.	**Transformation Kinetics** - Detailed study of the mathematical descriptions of decay processes, including decay constant and half-life calculations.	2

3.	**Activity Measurements** - Techniques for measuring radioactivity, including Geiger counters, scintillation counters, and calorimeters. Calibration and standardization methods.	2
4.	**Naturally Occurring Radiation** - Exploration of sources of natural radiation, including cosmic rays, radon, and terrestrial sources. Discussion on background radiation and its variability.	2
5.	**Serial Transformation Including Secular and Transient Equilibrium** - Analysis of radioactive decay series, focusing on secular and transient equilibrium between successive radioactive decays.	2
6.	**Interaction of Radiation with Matter: Beta Particles** - How beta particles interact with matter, including stopping power and range, bremsstrahlung, and applications in medical physics.	2
7.	**Interaction of Radiation with Matter: Alpha Particles** - Interaction mechanisms of alpha particles with matter, including range and ionization density, and their use in radiation therapy.	2
8.	**Interaction of Radiation with Matter: Gamma Rays** - Gamma ray interactions with matter, focusing on photoelectric effect, Compton scattering, and pair production.	2
9.	**Interaction of Radiation with Matter: Neutrons** - Neutron interaction with matter, including neutron moderation, absorption, and their implications for reactor physics and radiation shielding.	2
10.	**Radiation Dosimetry: Units and External Exposure** - Introduction to dosimetry units (Gray, Sievert), methods for measuring and calculating doses from external radiation sources.	2
11.	**Internally Deposited Radionuclides** - Study of the behavior and health impacts of radionuclides deposited inside the human body, including biokinetic models and dose coefficients.	2
12.	**External Exposure to Neutrons** - Safety standards and protective measures for neutron radiation, including neutron dosimetry and shielding strategies.	2
13.	**Biological Basis for Radiation Safety: Dose-Response Characteristics** - Explore dose-response relationships in radiobiology, including thresholds for damage and repair mechanisms in tissues.	2
14.	**Radiation Effects: Deterministic and Stochastic** - Detailed discussion on deterministic effects (e.g., radiation sickness) and stochastic effects (e.g., cancer risk) of radiation exposure.	2
15.	**Radiation-Weighted Dose Units: The Sievert and The Rem** - Explanation of radiation-weighted dose units and their significance in assessing radiation exposure risks in medical and environmental settings.	2

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	8th week	30%
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	• "Introduction to Health Physics" by Herman Cember and Thomas E. Johnson, Edition: 4th Edition, Publication Date: 2008, ISBN-13: 9780071423083 • "Radiation Detection and Measurement" by Glenn F. Knoll, Edition: 4th Edition, Publication Date: 2010, ISBN-13: 9780470131480
Supportive References	• Introduction to Radiological Physics and Radiation Dosimetry" by Frank Herbert Attix, Edition: 1st Edition, Publication Date: 1986, ISBN-13: 9780471011460 • "Physics for Radiation Protection" by James E. Turner, Edition: 3rd Edition, Publication Date: 2007, ISBN-13: 9783527406111 • "Radiation Physics for Medical Physicists" by Ervin B. Podgorsak, Edition: 3rd Edition, Publication Date: 2016, ISBN-13: 9783319253807
Electronic Materials	
Other Learning Materials	

2. Educational and Research Facilities and Equipment Required:

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

Items	Resources
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		

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

Assessment Methods (Direct, Indirect)

G. Specification Approval Data:

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

Course Specification
(Bachelor)

Course Title:	Laser
Course Code:	PHYS4404
Program:	Physics
Department:	Physics
College:	Science
Institution:	Umm Al-Qura University
Version:	47
Last Revision Date:	10/3/2025.

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: (……..)					
4. Course General Description:					
The purpose is to gain a solid understanding of the basic principles of lasers and to be aware with the operation of most common laser types. It demonstrates the basic physics of optical cavities and the spontaneous/stimulated emission processes that lead to laser amplifiers and oscillators. Properties of laser cavities and the optics of Gaussian beam and laser applications are discussed					
5. Pre-requirements for this course (if any)**:**					
Optics PHYS3402					
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. modern laser physics theory. 2. Characteristics of Lasers. 3. Energy Levels, Radiative and Non-radiative Transitions. 4. Laser components. 5. Laser systems and laser production. 6. Time dependent laser behavior. 7. Laser types. 8. Laser applications. 9. Laser hazards and safety.					

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 physics governing laser behavior and light matter interaction.	K1	Lectures	Exams, Homework, Quizzes
1.2	Describe different types of laser technology.	K2		
…				
2.0	Skills			
2.1	Solve problems in laser physics.	S1	Lectures	Exams, Homework, Quizzes
2.2	Apply the principles of atomic physics to materials used in lasers and optics.	S2		
…				
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	Exams, Homework, Quizzes
...				

C. Course Content

No	List of Topics	Contact Hours
1.	**Photon Optics** • The Photon, • Photon Streams, • Quantum States of Light,	4
2.	**Photons and Atoms** • Energy Levels, • Occupation of Energy Levels, • Interactions of Photons with Atoms, • Thermal Light, • Luminescence and Light Scattering.	4
3.	**Characteristics of Lasers** • The meaning of Laser, Laser history, • Light-matter interaction: absorption, spontaneous, stimulated emissions, • Optical properties of lasers	2
4.	**Energy Levels, Radiative and Non-radiative Transitions** • Atomic models: Thomson's, Rutherford's and modern atomic models, • Particles statistics, • Radiative and non-radiative transitions, • Einstein's equations, Saturation, • Molecular energy levels, • Energy levels in solids	2
5.	**Laser components** • Basic elements of a laser device, • Active medium, • Pumping: optical, electrical, chemical and nuclear, • Resonators: stability of Resonators, Laser cavity modes, Oscillators and amplifiers, Resonator quality factor	4
6.	**Laser systems and lasing production** • Three-and four-level laser systems, • Population inversion in Laser and Lasing threshold, Laser gain, • Laser output power optimization,	4

	• Laser efficiency, • Effective medium	
7.	**Time dependent laser behavior** • Q-switching, • Mode-locking, • Gain switching, • Linewidth broadening mechanism, • Spectral hole burning, • Spiking	**4**
8.	**Laser types** • Gas lasers: atomic, ionic and molecular lasers, • Liquid lasers, • Solid-state lasers, • Semiconductor Laser, • Other lasers: X-ray lasers and free electron lasers	**2**
9.	**Laser applications** • Scientific applications, • Military applications, • Laser in Industry, • Medical applications, • Other applications	**2**
10.	**Laser hazards and safety** • Laser classes, • Safety requirements and procedures	**2**
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.			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	• Fundamental of Photonics, B.E.A. Saleh and M.C.Teich, 2nd edition, WILEY (2006). • Principles of Lasers; Orazio Svelto. Springer; 5th edition (January 1, 2007)

	• Laser Fundamentals; William T. Silfvast; Cambridge University Press 2nd edition, 2012.
Supportive References	
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 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