Republic of Iraq
Ministry of Higher Education & Scientific Research
Supervision and Scientific Evaluation Directorate
Quality Assurance and Academic Accreditation

Academic Program Specification Form For The Academic

University: Anbar
College: Education for Pure Science
Department: Physics
Date Of Form Completion: 10/6/2023

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Dean's Name	Dean's Assistant For Scientific Affairs	Head of Department
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Quality Assurance And University Performance Manager

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TEMPLATE FOR PROGRAMME SPECIFICATION

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

PROGRAMME SPECIFICATION

This Programme Specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It is supported by a specification for each course that contributes to the programmer.

1. Teaching Institution	University of Anbar
2. University Department	College of education for pure science- Physics
3. Programmer Title	Education Physics Sciences
4. Title of Final Award	Master and Ph. D. of Physics
5. Modes of Attendance offered	Quarterly
6. Accreditation	Nothing
7. Other external influences	University application - practical graduation research projects
8. Date of production	1/9/2023
9. Aims of the Programmer	
1. Achieving the specified standards for the quality of material, human, technical and financial resources.	
2. Providing an efficient administrative staff that knows its duties and powers according to the work structures and regulations, in which the requirements of the job description are fulfilled**.**	
3. Providing a specialized teaching staff who is fluent in using modern techniques and methods in education with good job satisfaction.	
4. Preparing academic programs in accordance with international academic standards and providing their knowledge, training and technical requirements.	
5. Preparing students with scientific, practical and educational knowledge that meets the needs of the labor market.	
6. Paying attention to scientific research in terms of laboratory, research and researcher in order to achieve a distinguished research reputation locally and globally.	
7. Research and professional openness to community institutions to meet their needs and aspirations.	
8. Evaluate all individuals and processes to ensure quality performance and continuous improvement.	

10. Learning Outcomes, Teaching, Learning and Assessment Methods

A1. Knowledge and Understanding

A1. Enable the graduate student to acquire theoretical knowledge of Physics.
A2. Empowering the graduate student how to teach and ways of communicating scientific information to grudaute students.
A3. The student's knowledge of the methods of measurement and evaluation and methods of modern teaching methods in physics.
A4. The graduate student is acquainted with the educational material by providing it electronically in the virtual classroom. In addition to enabling the student to know the learning theories related to the ages of students for the secondary school stage.

B. Subject-specific skills

B1. Gaining knowledge and enriching the student with the methods of laboratory work.
B2. Orienting the student to the scientific method in solving all scientific problems.
B3. Knowing the objectives and origins of the art of teaching physics.
B4. Enabling students to acquire the skills of using virtual classrooms

Teaching and Learning Methods

1. The method of listening and thinking deeply in order to understand the problem to solve it.
2. The method of scientific discussion and meaningful dialogue.
3. Adopting the method of monthly and final exams and submitting weekly reports.

Assessment methods

1. The treatment method using final scores.
2. Random and surprise tests.
3. Teaching tasks in the virtual classroom.

C. Thinking Skills

C1. Adopting the method of dialogue between the student and the professor.
C2. Interest in research projects and preparing organized reports
C3. Adopt the method of discussion. (Performance tests and seminars).
C4. Adopting e-learning to provide an interesting and flexible learning environment.

Teaching and Learning Methods

1. Method of application in research laboratories
2. Adopting the method of constructive dialogue and discussion
3. Adopt the trial-and-error method.
4. The adoption of multimedia in the virtual classes (image, text, audio, video)

Assessment methods

1. Preparation of the seminar (graduation research)
2. Adoption of the grading method as a basis in the evaluation process.
3. Adoption of the test method.
4. Adopting the method of discussions and dialogues between the students and the professor.
5. Create a test task in the virtual classes.

D. General and Transferable Skills (other skills relevant to employability and personal development)

D1- That the student benefit from his learning and embody this in his personal and professional development.
D2- That the student is able to employ the knowledge he receives during the study stage.
D3- That the student benefit from theoretical knowledge in employing the teaching profession and mastering it in a concept-based manner.
Fundamentals of teaching chemistry.
D4 - Skills of modern technologies in communication, documentation and communication.

Teaching and Learning Methods

1. Field visits in laboratories.
2. Scientific application in laboratories.
3. Take advantage of graduation research.
4. Presentation and presentation of educational content in virtual classes using multimedia (video, recorded lecture).

Assessment Methods

1. Articles and periodical research
2. The interview
3. Final exams
4. Determining study tasks and duties periodically and regularly in the virtual classroom

11. Programmer Structure (Master)

Level/	Course or Module Code	Course or ModuleTitle	Weekly hours	
			Lec.	Lab.

Year				
Attending (First + Second) Class	PHE522	**Advanced Solid State Physics**	2	-
	PHE523	**Advanced Quantum Mechanics**	2	-
	PHE528	**Advanced Mathematical Physics**	2	-
	PHE526	**Electromagnetic theory**	2	-
	PHE524	**Advanced Nuclear Physics**	2	-
	PHE540	**English**	2	-
	PHE532	**Modern trends in teaching methods**	2	-
	PHE525	**Classical mechanics**	2	-
	PHE529	**Statistical Mechanics**	2	-
	PHE521	**Physics of materials**	2	-
	PHE527	**elective**	2	-
	PHE530	**Scientific Research Methodology and Statistics**	2	-
	PHE531	**Educational Technology**	2	-
Research class		**Thesis Project**	4	-

11. Programmer Structure (Ph.D.)				
Level/ Year	**Course or Module Code**	**Course or ModuleTitle**	**Weekly hours**	
			Lec.	**Lab.**
Attending (First + Second) Class	PHE621	**Optoelectronics**	2	-
	PHE623	**Advanced Quantum Mechanics**	2	-
	PHE627	**Advanced Electrodynamic**	2	-
	PHE628	**Advanced Mathematical Physics**	2	-
	PHE629	**Teaching and Learning System**	2	-
	PHE630	**Scientific Research Methodology and Statistics**	2	-
	PHE528	**Quantum optics**	2	-
	PHE622	**Advanced solid state physics**	2	-
	PHE631	**High Energies**	2	-
	PHE632	**Special topic 1**	2	-
	PHE633	**Special topic 2**	2	-
	PHE640	**English**	2	-
Research class		**Thesis Project**	4	-

13. Personal Development Planning
1. Using modern scientific sources. 2. Using rapid communication networks to transfer information such as the Internet. 3. Visits and practical practices in service laboratories. 4. Acquisition of scientific and modern experiences and skills in the field of modern technical communication
14. Admission criteria
1. Admission according to the general and central average system. 2. Admission to departments is according to the student's desire and is modified. 3. It is a condition for a graduate of the preparatory school and the scientific stream exclusively. 4. The accepted graduate student's personal and mental integrity and freedom from physical impairments
15. Key sources of information about the programmer
1. Curriculum books approved by the Sectorial Committee of the Faculties of Education for Pure Sciences. 2. Helping books. 3. Books and archaeological resources / sources in the English language. 4. Additional sources from the Internet. 5. The training courses held by the university on e-learning platforms.

Curriculum Skills Map (Master)

Year / Level	Course Code	CourseTitle	Core (C) or Option(O)	Programmer Learning Outcomes															
				Knowledge and understanding				Subject-specific skills				Thinking Skills				General and Transferable Skills (or) Other skills relevant to employability and personal development			
				A1	**A2**	**A3**	**A4**	**B1**	**B2**	**B3**	**B4**	**C1**	**C2**	**C3**	**C4**	**D1**	**D2**	**D3**	**D4**
Attending (First +Second)	PHE522	**Advanced Solid State Physics**	Core	√	√	√		√	√			√	√			√	√	√	√
	PHE523	**Advanced Quantum Mechanics**	Core	√		√		√	√			√				√			
	PHE528	**Advanced Mathematical Physics**	Core	√		√		√	√			√				√			
	PHE526	**Electromagnetic theory**	Core	√		√		√	√			√				√			
	PHE524	**Advanced Nuclear Physics**	Core	√		√		√	√			√				√			
	PHE540	**English**	Core	√		√		√	√			√				√			
	PHE532	**Modern trends in teaching methods**	Core	√		√		√	√			√				√			
	PHE525	**Classical mechanics**	Core	√		√		√	√			√				√			
	PHE529	**Statistical Mechanics**	Core	√		√		√	√			√				√			
	PHE521	**Physics of materials**	Core	√		√		√	√			√				√			
	PHE527	**elective**	Core			√		√	√			√				√			
	PHE530	**Scientific Research Methodology and Statistics**	Core			√		√	√			√				√			
	PHE531	**Educational Technology**	Core			√		√	√			√				√			
Second Year Researcher	**MAT515**	Thesis Project	Core	√		√		√	√			√				√			

Curriculum Skills Map (Ph.D.)

Year / Level	Course Code	CourseTitle	Core (C) or Option(O)	Programmer Learning Outcomes															
				Knowledge and understanding				Subject-specific skills				Thinking Skills				General and Transferable Skills (or) Other skills relevant to employability and personal development			
				A1	**A2**	**A3**	**A4**	**B1**	**B2**	**B3**	**B4**	**C1**	**C2**	**C3**	**C4**	**D1**	**D2**	**D3**	**D4**
Attending (First +Second)	PHE621	**Optoelectronics**	Core	√	√	√		√	√			√	√			√	√	√	√
	PHE623	**Advanced Quantum Mechanics**	Core	√		√		√	√			√				√			
	PHE627	**Advanced Electrodynamic**	Core	√		√		√	√			√				√			
	PHE628	**Advanced Mathematical Physics**	Core	√		√		√	√			√				√			
	PHE629	**Teaching and Learning System**	Core	√		√		√	√			√				√			
	PHE630	**Scientific Research Methodology and Statistics**	Core	√		√		√	√			√				√			
	PHE528	**Quantum optics**	Core	√		√		√	√			√				√			
	PHE622	**Advanced solid state physics**	Core	√		√		√	√			√				√			
	PHE631	**High Energies**	Core	√		√		√	√			√				√			
	PHE632	**Special topic 1**	Core			√		√	√			√				√			
	PHE633	**Special topic 2**	Core			√		√	√			√				√			
	PHE640	**English**	Core			√		√	√			√				√			

Ministry of Higher Education and Scientific Research
Scientific supervision and evaluation device
Department of Quality Assurance and Academic Accreditation
International Accreditation Department

COURSE SPECIFICATION

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

COURSE SPECIFICATION

This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	University of Anbar
2. University Department/Centre	College of Education for Pure Sciences / Department of Physics
3. Course title/code	Advanced mathematic physics
4. Programme(s) to which it contributes	PhD. Degree in physics
5. Modes of Attendance offered	Presence
6. Semester/Year	First semester 2023-2024
7. Number of hours tuition (total)	2 hours
8. Date of production/revision of this specification	1/6/2024
9. Aims of the Course	
-The student learns how to solve equations using matrices and Cramer's method	
-The student learns how to solve equations using the matrix inverse method	
-The student learns how to find the eigen value and eigen vector for a number of applied problems in quantum mechanics	
-Learn about geometric functions and how to solve differential equations using the Frobenius method	
-The student learns how to find the signal type in Fourier series electronic circuits	
-The student learns how to solve equations using matrices and Cramer's method	
-The student learns how to solve equations using the matrix inverse method	

10· Learning Outcomes, Teaching ,Learning and Assessment Methode

A- Knowledge and Understanding

A1- Graduate students understand how to solve many advanced physics problems using advanced mathematics.

A2. The student will understand how to solve equations using matrices and Cramer's method and finding the inverse of the matrix

A3. - The student understands how to find the eigen value and the eigen vector

B. Subject-specific skills

B1. –—The skill of using advanced mathematics to solve some physics problems, including nuclear, electrodynamics, quantum mechanics, electromagnetism, and others.

Teaching and Learning Methods

-Lecture ,discussion ,and solving of problem.

Assessment methods

-Short question - Activity -Duties – Final exam.

C. Thinking Skills

C1. - Advanced mathematics develops the thinking and imagination skills of postgraduate students and develops their skills by solving mathematical problems related to other physical sciences.

Teaching and Learning Methods

-Lecture ,discussion ,and questioning.

Assessment methods

Percentage evaluation methods

1 monthly exam 20

2 Activity and duties 5

3 Oral exam 5

4 Final exam 70

Total 100%

D. General and Transferable Skills (other skills relevant to employability and personal development)

D1. Many problems in advanced physics, such as quantum mechanics, electrodynamics, and electromagnetism, require advanced mathematics, such as the Lagender function and bezel eu..

11. Course Structure

Week	Hours	ILOs	Unit/Module or Topic Title	Teaching Method	Assessment Method
1	2	student learn nd **Vectors & Matrix:**	**CH-1:Vectors & Matrix:1st) Group,2nd : Vector space V**	Lecture with data show	Discussion, Short questions
2	2	student learn Vector Space, Subspace	Real Vector Space, Subspace, Spaning set, linearly dependent, independence of matrix,	Lecture with data show	Discussion, Short questions
3	2	student learn Range ,Rank, and Nullity	linear transformation, Inverse of the linear transformation, Kernel, Range ,Rank, and Nullity	Lecture with data show	Discussion, Short questions
4	2	student learn matrix method, Grammars' Method,	CH.2 / Matrices and Determinations, Solving of linear equations by matrix method, Grammars' Method, Eigen Value and Eigen Vector	Lecture with data show	Discussion, Short questions
5	2		Test 1		
6	2	student learn Frobenius series	CH-4: Engineering Analytic ,Frobenius series	Lecture with data show	Short questions
7	2	student learn Fourier series.	Laplace Transform, Fourier series	Lecture with data show	Discussion, Short questions
8	2	student learn Jacobi's Method	Solving the system of linear equations, Jacobi's Method	Lecture with data show	Short questions
9	2	student learn	Jacobian matrix, Gauss-seidel	Lecture with data show	Discussion, Short questions
10	2	student learn Gauss-seidel	Partial derivatives using Jacobian	Lecture with data show	Discussion, Short questions
11	2		Test 2		
12	2	student learn , Bessel eq.	Solving Partial D.E using operator method, Bessel eq.	Lecture with data show	Discussion, Short questions
13	2	student learn Trapezoidal rule	CH-5:/Numerical integration methods1-Rectagular rule 2-Trapezoidal rule	Lecture with data show	Discussion, Short questions
14	2	student learn	3- Integration by Simpson’s rule	Lecture with data show	Short questions
15	2	student learn Gaussain	Gaussain integration formula	Lecture	, Short

12. Infrastructure	
Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	1-Aplied numerical methods for digital computation , M.J james , G.M th and J.C Watrol 2-Matrix and Tensors in physics by A W. Joshi
Special requirements (include for example workshops, periodicals, IT software, websites)	-Introduction to numerical methods by A .Star K1 -Mathmatical method in phys. ,vol.1 Byron2
Community-based facilities (include for example, guest Lectures , internship , field studies)	1 Mathmatical methods in the physical Sciences 3rd Edition Mary L. Boas Depaul university 2- Advanced engineering mathematics fifth edition, Wile

13. Admissions	
Pre-requisites	Master degree
Minimum number of students	4
Maximum number of students	15

COURSE SPECIFICATION

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

COURSE SPECIFICATION

This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	University of Anbar
2. University Department/Centre	College of Education for Pure Sciences / Department of Physics
3. Course title/code	Advanced mathematic physics
4. Programme(s) to which it contributes	M.Sc
5. Modes of Attendance offered	Presence
6. Semester/Year	First semester 2023-2024
7. Number of hours tuition (total)	2 hours
8. Date of production/revision of this specification	1/6/2024
9. Aims of the Course	
-The student should know the types of differential equations and ways to solve each type	
The student should know the special functions such as Lagendre, Bezel, Hermitian, LAGURE, chephiff, and other equations.	
-The student should know the most important methods of integration, including the gamma and beta functions, the relationship between them, the error function, and others	
-The student should know the methods of numerical integration, including the simpson rule	

10· Learning Outcomes, Teaching ,Learning and Assessment Methode
A- Knowledge and Understanding A1.The student may understands to students in modern mathematics ,and some its applications.
B. Subject-specific skills B1. Developing students' understanding of modern mathematics so that they can solve basic theories and hypotheses in advanced physic,
Teaching and Learning Methods
-Lecture ,discussion ,and solving of problem.
Assessment methods
-Short question - Activity -Duties – Final exam.
C. Thinking SkillsC1. Ask any questions and home work.
Teaching and Learning Methods
-Lecture ,discussion ,and questioning.
Assessment methods
Percentage evaluation methods 1 monthly exam 20 2 Activity and duties 5 3 Oral exam 5 4 Final exam 70 Total 100%

D. General and Transferable Skills (other skills relevant to employability and personal development)

D1. Many problems in advanced physics, such as quantum mechanics, electrodynamics, and electromagnetism, require advanced mathematics, such as the Lagender function and bezel eu..

11. Course Structure

Week	Hours	ILOs	Unit/Module or Topic Title	Teaching Method	Assessment Method
1	2	Student learn O.D.E	Chapter one /Ordinary Differential Equations Simple substuting - Variable separable - *homgeous*	Lecture with data show	Short questions
2	2	Student learn Exact D.E	linear D.E – Exact D.E	Lecture with data show	Short questions
3	2	Student learn	Bernoulli's Equation- D.E. S with constant coefficients	Lecture with data show	Short questions
4	2	Student learn sequential method	power series- sequential method	Lecture with data show	Short questions
5	2		Test 1		
6	2	Student learn Legendre'sD.E-	Ch 2 : Spatial functions - Legendre's D.E-	Lecture with data show	Short questions
7	2	Student learn Bessel's D.E	Bessel's D.E	Lecture with data show	Short questions
8	2	Student learn	Hermite D.E	Lecture with data show	Short questions
9	2	Student learn Laguerre D.	Laguerre D.E	Lecture with data show	Short questions
10	2	Student learn Chebyshev polynomials	Chebyshev polynomials:	Lecture with data show	Short questions
11	2		Test 2		
12	2	Student learn Gamma, Beta Functions , Asymptotic Series	CH-3:/Gamma, Beta , and Error Functions , Asymptotic Series **Sterling's** formulas "Elliptic Integrals and functions- Factorial Function	Lecture with data show	Short questions
13	2	Student learn BETA FUN.	BETA FUNCTIONS- ERROR FUNCTION	Lecture with data show	Short questions
14	2	Student learn Elliptic fun.	ELLIPTIC INTEGRALS AND FUNCTIONS	Lecture with data show	Short questions
15	2	Student learn Simpons rule	Ch-4Numerical integration Simpons rule	Lecture with data show	Short questions

12. Infrastructure	
Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	1- calculus and Analytic Geomery 6 th Edition) Thomas . finney (1984) Addison Wesley cha.
Special requirements (include for example workshops, periodicals, IT software, websites)	1- Mathematical methods in the physical sciences boas , mary (1966) john wiley sons. 2- Introduction to Mathematical physics Charlie Harper (1976) prentice Hall
Community-based facilities (include for example, guest Lectures , internship , field studies)	1- Methods of Mathematical physics Jeffeys . Jeffreys (1972) combridge university press. 2-Watch videos posted on the university website

13. Admissions	
Pre-requisites	Bachelor's degree
Minimum number of students	4
Maximum number of students	15

COURSE SPECIFICATION

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

COURSE SPECIFICATION

This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	University of Anbar
2. University Department/Centre	Education for pure sciences
3. Course title/code	PHD Degree
4. Programme(s) to which it contributes	PHD Degree in physics
5. Modes of Attendance offered	
6. Semester/Year	Second / 2023-2024
7. Number of hours tuition (total)	3
8. Date of production/revision of this Specification	4-6-2024
9. Aims of the Course	
The student will know the working principle of advanced solid state physics	
The student will delve into solid state physics in its structural nature from its practical and theoretical aspects	
Study the models of density functional theory and the concepts of working through it	

10. Learning Outcomes, Teaching, Learning and Assessment Methods
A. Knowledge and Understanding A1- The student understands the nanostructure A2- The student understands the Schrödinger equation for solid particles A3- The student learns the concept of density functional theory A4- The student understands the latest research results in this field
B. Subject-specific skills B.1 The student concludes that nanostructure in terms of size is of great importance in industry and technology B.2 The student distinguishes between the different effects of the density functional theory, Hartree and Hartree-Fock B.3 The student learns the benefits that are obtained by solving the expressions of the equation
Teaching and Learning Methods
The theoretical lectures include theoretical explanation in addition to solutions to mathematical problems and conclusions using the board and display screens.. The latest industries and technologies that these technologies have worked on are also reviewed.
Assessment methods
Through daily and monthly exams, as well as the student’s classroom activity and interaction with the lesson material
C. Thinking Skills C.1 The student learns how to visualize and describe properties by solving these hypotheses. C.2 Use this science in technological development and industry
Teaching and Learning Methods
The theoretical lectures include theoretical explanation in addition to solutions to mathematical problems and conclusions using the board and display screens.. The latest industries and technologies that these technologies have worked on are also reviewed.
Assessment methods
Through daily and monthly exams, as well as the student’s classroom activity and interaction with the lesson material

D. General and Transferable Skills (other skills relevant to employability and personal development)
D1. The student should know how to deal with solving equations by using hypotheses.
D2. This science should be used in technological development and industry.
D3. The physical properties that make the solid materials used in the highest specifications in their physical and engineering forms should be known.

11. Course Structure

Week	Hours	ILOs	Unit/Module orTopic Title	Teaching Method	Assessment Method
1	3	Schrödinger Equation	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
2	3	Born–Oppenheimer Approximations	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
3	3	Hartree Approximations	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
4	3	Hartree–Fock Approximations	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
5	3	Restricted Hartree–Fock (RHF) Method	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
6	3	Unrestricted Hartree-Fock (UHF) Method	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
7	3		First month exam		
8	3	Linear Combination of Atomic Orbitals (LCAO) and The	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
9	3	Rothaan–Hall Equations	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
10	3	Slater-type Orbitals	Schrödinger formula, its solution and approximations	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
11	3	Gaussian-type Orbitals	Schrödinger formula, its solution and	A theoretical explanation on the board with	Daily exam, discussion, assignments, and monthly exams

			approximations	examples	
12	3	Ab-initio Method	And dealing with nanofibers	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
13	3	Density Functional Theory	Wave mechanics	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
14	3	The Hohenberg-Kohn Theorem (HK)	And dealing with nanofibers	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
15	3		Second month exam		

12. Infrastructure	
Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	**1- Solid State Physics / Dr. Moaeed Gabriel.** **2- Electrical and magnetic properties / Dr. Wakaa Al-Jubouri and Dr. Fahd Ghalib.** **3. Solid state physics / Dr. Yahya Nouri Al-Jamal/University of Mosul**
Special requirements (include for example workshops, periodicals, IT software, websites)	**Introduction to Solid State Physics : Charles Kittel-8th**
Community-based facilities (include for example, guest Lectures , internship , field studies)	International Journal of Nanoscience International journal of Optics

13. Admissions	
Pre-requisites	
Minimum number of students	3
Maximum number of students	6

COURSE SPECIFICATION

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This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	Uiversity of Anbar
2. University Department/Centre	Education for pure sciences
3. Course title/code	Ph.D. Degree
4. Programme(s) to which it contributes	PhD. Degree in physics
5. Modes of Attendance offered	
6. Semester/Year	Second / 2023-2024
7. Number of hours tuition (total)	
8. Date of production/revision of this specification	4-6-2024
9. Aims of the Course	
Course objectives: The student knows the importance of using high energy	
The student will delve deeply into the study of elementary particles	
Study of models related to the origin of the universe	

10· Learning Outcomes, Teaching ,Learning and Assessment Methode

A- Knowledge and Understanding

A1. The student understands elementary particles

A2 The student understands the interaction of particles with each other

A3. The student learns the methods of radioactivity

A4. For the student to understand the latest research results in this field

B. Subject-specific skills

B. 1 The student concludes that conservation laws are important in physics

B. 2 The student distinguishes between the different effects between matter and radiation

B. 3 The student learns all the laws of memorization

Teaching and Learning Methods

Theoretical lectures include theoretical explanation as well as solutions to mathematical problems and derivations using the blackboard

Assessment methods

Through daily and monthly exams, as well as the student's classroom activity and interaction with the lesson material

C. thinking skills

C. 1 The student knows how to imagine and describe the nucleus and develop a new model

C. 2 To use this science in technological development and industry

Teaching and Learning Methods

Theoretical lectures include theoretical explanation as well as solutions to mathematical problems and derivations using the blackboard

Assessment methods

Through daily and monthly exams, as well as the student's classroom activity and interaction with the lesson material

D. General and Transferable Skills (other skills relevant to employability and personal development)
D1. The student knows how to measure nuclear energy and analyze its results
D2. This science should be used in technological development and industry

11. Course Structure

Week	Hours	ILOs	Unit/Module orTopic Title	Teaching Method	Assessment Method
1	2	Familiarizing the student with the basics of high energy	Basic concepts in nuclear physics	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
2	2	Introducing the student to the standard model of particle physics	The Standard Model of particle physics	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
3	2	Familiarizing the student with nuclear power and its interactions	*The interactions*	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
4	2	Knowledge of bodies and antibodies	POSITRONS AND OTHER ANTIPARTICLES	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
5	2	See particle classification	CLASSIFICATION OF PARTICLES	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
6	2	Knowledge of conservation laws	CONSERVATION LAWS	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
7	2	First month exam	fiirst month exam	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
8	2	Study of quark interaction and color character	QUARKS AND COLOR	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
9	2	Interactions and domains	Interactions and fields	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
10	2	Calculating nuclear moments	Classical and quantum pictures of interactions	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
11	2	Phi chart of	Feynman diagrams	A theoretical explanation on the	Daily exam, discussion, assignments, and monthly

				board with examples	exams
12	2	The student's knowledge of the cross section	The interaction cross-section	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
13	2	Familiarizing the student with fixed and variable basics	Invariance principles and conservation laws	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
14	2	Calculating orbital angular momentum	Parity of particles and antiparticles	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
15	2	Second month exam	Second month exam	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams

12. Infrastructure	
Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	1- Introductory Nuclear Physics, Kenneth S. Krane Oregon State University, 1987. 2---Fundamentals in Nuclear Physics, Jean-Louis Basdevant, Jame Rich and Michal Spiro, Springer, 2004.
Special requirements (include for example workshops, periodicals, IT software, websites)	Internet International journals
Community-based facilities (include for example, guest Lectures , internship , field studies)	

13. Admissions	
Pre-requisites	
Minimum number of students	
Maximum number of students	

COURSE SPECIFICATION

HIGHER EDUCATION PERFORMANCE REVIEW: PROGRAMME REVIEW

COURSE SPECIFICATION

This Course Specification provides a concise summary of the main features of the course and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if he/she takes full advantage of the learning opportunities that are provided. It should be cross-referenced with the programme specification.

1. Teaching Institution	Uiversity of Anbar
2. University Department/Centre	Education for pure sciences
3. Course title/code	Master Degree
4. Programme(s) to which it contributes	Master Degree in physics
5. Modes of Attendance offered	
6. Semester/Year	First / 2023-2024
7. Number of hours tuition (total)	
8. Date of production/revision of this specification	4-6-2024
9. Aims of the Course	
The student knows the nuclear structure	
The student will delve deeply into nuclear physics	
Study nuclear models in depth	

10· Learning Outcomes, Teaching ,Learning and Assessment Methode

A- Knowledge and Understanding

A1- The student understands nuclear structure

A2- The student understands nuclear models

A3- The student learns the methods of radioactivity

A4- That the student understands the latest research results in this field

B. Subject-specific skills

B. 1 The student concludes that the atom and atomic structure are of great importance in industry and technology

B. 2 The student distinguishes between the different effects between matter and radiation

B. 3 The student learns the dangers of atomic radiation and the dangers of the atom

Teaching and Learning Methods

Theoretical lectures include theoretical explanation as well as solutions to mathematical problems and derivations using the blackboard

Assessment methods

Through daily and monthly exams, as well as the student's classroom activity and interaction with the lesson material

C. thinking skills

C. 1 The student knows how to imagine and describe the nucleus and develop a new model

C. 2 To use this science in technological development and industry

Teaching and Learning Methods

Theoretical lectures include theoretical explanation as well as solutions to mathematical problems and derivations using the blackboard

Assessment methods

Through daily and monthly exams, as well as the student's classroom activity and interaction with the lesson material

D. General and Transferable Skills (other skills relevant to employability and personal development)
D1. The student knows how to measure nuclear energy and analyze its results
D2. This science should be used in technological development and industry

11. Course Structure

Week	Hours	ILOs	Unit/Module orTopic Title	Teaching Method	Assessment Method
1	2	Familiarizing the student with the basics of nuclear physics	Basic concepts in nuclear physics	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
2	2	Introducing the student to the quantitative levels of the nucleus	Quantum states of nuclei	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
3	2	Familiarizing the student with nuclear power and its interactions	Nuclear forces and interactions	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
4	2	Knowledge of conservation laws	Conservation laws	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
5	2	View nuclear models	Nuclear models	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
6	2	Exposing the student to radioactivity	Radioactive Decay	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
7	2	First month exam	First month exam	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
8	2	Study of the interaction and force between the two nucleons	The Forces between Nucleons	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
9	2	Study of the simplest element, deuteron	The Deuteron	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
10	2	Calculating nuclear moments	Magnetic Dipole Moment	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
11	2	Study of scattering resulting from nucleons	Nucleon-nucleon Scattering	A theoretical explanation on the board with	Daily exam, discussion, assignments, and monthly exams

				examples	
12	2	The student's knowledge of neutron sources	Neutron Sources	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
13	2	Exposing the student to ways to calm down and absorb neutrons	Absorption and Moderation of Neutrons	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
14	2	Calculating orbital angular momentum	Neutron detectors	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams
15	2	Second month exam	Second month exam	A theoretical explanation on the board with examples	Daily exam, discussion, assignments, and monthly exams

12. Infrastructure	
Required reading: · CORE TEXTS · COURSE MATERIALS · OTHER	1- Introductory Nuclear Physics, Kenneth S. Krane Oregon State University, 1987. 2---Fundamentals in Nuclear Physics, Jean-Louis Basdevant, Jame Rich and Michal Spiro, Springer, 2004.
Special requirements (include for example workshops, periodicals, IT software, websites)	Internet International journals
Community-based facilities (include for example, guest Lectures , internship , field studies)	

13. Admissions	
Pre-requisites	
Minimum number of students	
Maximum number of students	

Course Description Form

Review the performance of higher education institutions ((Academic Program Review)

This course description provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the student to achieve.
Proving whether he has made the most of the available learning opportunities. It must be linked to the description of program.

University Of Anbar	**1. Educational institution**
College of Education for Pure Sciences / Department of Physics	**2. University Department / Center**
Advanced quantum mechanics	**3. Course Name/Code**
M.Sc.	**4. Programs in which it enters**
Presence	**5. Available Attendance Forms**
First Semester / 2023-2024	**6. Semester / Year**
3 hours	**7. Number of Credit Hours (Total)**
1Sept. 2024	**8. The history of preparation of this description**
9. Course Objectives:	
The student knows quantum mechanics in electromagnetic fields , Lorentz transformations , Angular momentum in electromagnetic fields in viewing of Q.M. and relativistic quantum mechanics equations	

10. Learning outcomes and methods of teaching, learning and evaluation

A. Knowledge and understanding

The student may understands the quantum mechanics in electromagnetic fields , Lorentz transformations , Angular momentum in electromagnetic fields in viewing of Q.M. and relativistic quantum mechanics equations

B. Subject-specific skills

Development of understand to students in modern mathematics , electromagnetics and quantum mechanics

- **Teaching and learning methods**

- Lecture, discussion, short reports, problem solving

- **Evaluation methods**

- Monthly test (essay and topical)
-Activity
-Short questions
-Reports
-Duties
-Final Exam

C. Thinking skills

- Ask various questions and brainstorm

-

- **Teaching and learning methods**

- Discussion, lecture, questioning

- **Evaluation methods**

1. Achievement Tests
2. Test methods (interview and observation)
3. Student feedback

D. General and transferable Skills (other skills related to employability and personal development).

Q.M. in EM fields needs to modern mathematical and understanding to all laws in EM an Electrodynamics also relativistic Q.M needs to know more on Relativity

11. Course Structure

Evaluation method	Method of education	Name of the unit/course or topic	Required Learning Outcomes	Hours	The week
Short questions	Lecture	**Relativistic Wave Equations and their Derivation Klein–Gordon Equation , Derivation by Means of the Correspondence Principle**		3	1
Short questions	Lecture	**The Continuity Equation , Free Solutions of the Klein–Gordon Equation ,Dirac Equation , Derivation of the Dirac Equation ,The Continuity Equation**		3	2
Short questions	Lecture	**Properties of the Dirac Matrices , The Dirac Equation in Covariant**		3	3
Short questions	Lecture	**Nonrelativistic Limit and Coupling to the Electromagnetic Field , Problems**		3	4
Short questions	Lecture	**Lorentz Transformations and Covariance of the Dirac Equation, Lorentz Transformations , Lorentz Covariance of the Dirac Equation**		3	5
Short questions	Lecture	**Lorentz Covariance and Transformation of Spinors , Determination of the Representation S(Λ) , Further Properties of**			6

		S , Transformation of Bilinear Forms			
Short questions	Lecture	**Properties of the γ Matrices , Solutions of the Dirac Equation for Free Particles**		3	7
		Test 1		3	8
Short questions	Lecture	**Spinors with Finite Momentum , Orthogonality Relations and Density , Operators ,** . **Problems**		3	9
Short questions	Lecture	**Orbital Angular Momentum and Spin Passive and Active Transformations**		3	10
Short questions	Lecture	**Rotations and Angular Momentum , Problems**		3	11
Short questions	Lecture	**The Coulomb Potential Klein–Gordon Equation with Electromagnetic Field**		3	12
Short questions	Lecture	**Coupling to the Electromagnetic Field , Klein–Gordon Equation in a Coulomb Field**		3	13
Short questions	Lecture	**Dirac Equation for the Coulomb Potential Problems**		3	14
		Tset 2		3	15

12. Infrastructure	
1-Advanced Quantum Mechanics by Franz Schwabl **2- Quantum Mechanics by LEONARD I. SCHIFF** **3-Introduction to Quantum mechanics by D.J. Griffiths** **4-Quantum Mechanics by Eugen Merzbacher**	Required readings : 1. Course Books 2. Other
• PowerPoint	Special Requirements
Attending scientific seminars	Social services (e.g. guest lectures, vocational training and field studies)

13. Acceptance	
	Prerequisites
10	Minimum number of students
14	The largest number of students

Course Description Form

Review the performance of higher education institutions ((Academic Program Review)

This course description provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the student to achieve.
Proving whether he has made the most of the available learning opportunities. It must be linked to the description of program.

University Of Anbar	**1. Educational institution**
College of Education for Pure Sciences / Department of Physics	**2. University Department / Center**
Quantum Optics	**3. Course Name/Code**
Ph.D	**4. Programs in which it enters**
Presence	**5. Available Attendance Forms**
Second Semester / 2023-2024	**6. Semester / Year**
3 hours	**7. Number of Credit Hours (Total)**
1 feb.. 2024	**8. The history of preparation of this description**
9. Course Objectives:	
The student knows how in quantum mechanics can deal between rays and materials and how in quantum mechanics dealing with optics and with several electromagnetic fields equations	

10. Learning outcomes and methods of teaching, learning and evaluation

A. Knowledge and understanding

To let students know ,how in quantum mechanics can deal between rays and materials and how in quantum mechanics dealing with optics and with several electromagnetic fields equations

B. Subject-specific skills

Development of understand to students in modern mathematics , electromagnetics and quantum mechanics also and optics

- **Teaching and learning methods**

- Lecture, discussion, short reports, problem solving

- **Evaluation methods**

- Monthly test (essay and topical)
-Activity
-Short questions
-Reports
-Duties
-Final Exam

C. Thinking skills

- Ask various questions and brainstorm

-

- **Teaching and learning methods**

- Discussion, lecture, questioning

- **Evaluation methods**

1. Achievement Tests
2. Test methods (interview and observation)
3. Student feedback

D. General and transferable Skills (other skills related to employability and personal development).

Quantum optics needs to modern mathematical and understanding to all laws in EM an Electrodynamics also Q.M

11. Course Structure

Evaluation method	Method of education	Name of the unit/course or topic	Required Learning Outcomes	Hours	The week
Short questions	Lecture	**Quantization of the lectromagnetic Field , Classical Electromagnetic Field, Hamiltonian Structure of the Classical Electromagnetic Quantization Field, of a Single Field Mode**		3	1
Short questions	Lecture	**Quantization of Many Modes Transverse and Longitudinal Fields Field commutators**		3	2
Short questions	Lecture	**Hamiltonian Viewpoint of Electromagnetic Gauge Freedom 1-10 Quantization with Dielectric Media Processes**		3	3
Short questions	Lecture	**Atomic Interaction with the Quantized Field Lorentz Force Lagrangian , Hamiltonian**		3	4
Short questions	Lecture	**Quantization and Minimal Coupling Dipole Interaction Why the Vector Potential Multipole Interactions Center-of-Mass Röntgen**		3	5
					6

Short questions	Lecture	**QED with Dielectric Media Classical electrodynamics in Dielectric Media Linear, Dispersive Media, Frequency Domain , Time Domain Classical Green Tensor , Example**		3	7
Short questions	Lecture	**Green Tensor in Free Space: Alternate Forms , Derivation of the Formula for the Dipole Radiation Field , Permittivity Properties, Energy Loss and Poynting's Theorem Kramers–Kronig Relations , Imaginary Frequencies**		3	8
Short questions	Lecture	**Generalized Susceptibility and Linear-Response Theory Proof, Atom and Field Susceptibilities 3-3 Atom–Surface Potentials Near Dielectric Media Kramers–Heisenberg Formula, Green Tensor , Mode Expansion of the Green Tensor Interaction Energy , Renormalization , Planar Interface ,**		3	9
Short questions	Lecture	**The Dirac Equation Lorentz Invariance of the Dirac Equation Solutions of the Free Particle Dirac Near-Field Equation van der Waals–London Potential,**		3	10

		Far-Field Potential , General Form for Scalar Polarizabilities , Temperature Dependence , Fluctuation–Dissipation Relation ,Fluctuation–Dissipation Example: Johnson Noise , Temperature-Dependent Shifts , Imaginary Time and the Low-Temperature Limit , High-Temperature Limit , Planar Boundaries at Nonzero Temperature .			
Short questions	Lecture	**Spinor Spinors Tensors**		3	11
Short questions	Lecture	Excited-Level Shifts , Example: Spherically Symmetric Atom, Perfectly Conducting Plane , Lifetime Shifts , Decay Rate Near a Macroscopic Body , Free Space: Green-Tensor Example, Planar Reflector		3	12
Short questions	Lecture	**امتحان شهر ثاني**		3	13
Short questions	Lecture	Casimir Energy of Dispersive Dielectric Bodies , Induced Interaction Energies, Assembling a Dielectric Medium, Atom by Atom , Conversion to Permittivity , Introduction of the Dielectric Green Tensor , Explicit Permittivity Dependence		3	14
Short questions	Lecture	Free-Space Energy, Reduction to the Casimir–Polder Potential , Temperature Dependence, **Counting Photons Beam Splitters**		3	15

12. Infrastructure	
1-Quantum and Atom Optics by Daniel .Adam Steck, revision 24 September 2020 **2-Introduction to Quantum Optics: an amateur's view Lecture notes, M.I. Petrov, .D.F. Kornovan, I.V. Toftul, 2019** **3-Lecture notes "Quantum optics" Friedrich-.Schiller-Universit¨, Frank Setzpfandt, 2018**	Required readings : 1. Course Books 2. Other
• PowerPoint	Special Requirements
Attending scientific seminars	Social services (e.g. guest lectures, vocational training and field studies)

13. Acceptance	
	Prerequisites
3	Minimum number of students
5	The largest number of students

Course Description Form

Review the performance of higher education institutions ((Academic Program Review)

This course description provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the student to achieve.
Proving whether he has made the most of the available learning opportunities. It must be linked to the description of program.

University Of Anbar	**1. Educational institution**
College of Education for Pure Sciences / Department of Physics	**2. University Department / Center**
Classical Mechanics	**3. Course Name/Code**
M.Sc.	**4. Programs in which it enters**
Presence	**5. Available Attendance Forms**
First Semester / 2023-2024	**6. Semester / Year**
2 hours	**7. Number of Credit Hours (Total)**
1 feb. 2024	**8. The history of preparation of this description**
9. Course Objectives:	
The student knows motion of systems in general coordinates , conservations energy of systems , Lagrange equations , Hamilton equation , virial theorem , cyclic coordinates and Ruth,s procedure .	

10. Learning outcomes and methods of teaching, learning and evaluation

A. Knowledge and understanding

The student may understands how describe motion of system and learn how drive Himaltion and Lagrange equations from each other . how to applied virial theorem on systems ,and when will use cyclic coordinates

B. Subject-specific skills

Development of understand to students in classical laws in physics which is based to modern physics .

- **Teaching and learning methods**

- Lecture, discussion, short reports, problem solving

- **Evaluation methods**

- Monthly test (essay and topical)
-Activity
-Short questions
-Reports
-Duties
-Final Exam

C. Thinking skills

- Ask various questions and brainstorm

-

- **Teaching and learning methods**

- Discussion, lecture, questioning

- **Evaluation methods**

1. Achievement Tests
2. Test methods (interview and observation)
3. Student feedback

D. General and transferable Skills (other skills related to employability and personal development).

Classical mechanic needs to know all classical laws of motion and theorems that applied in this field

11. Course Structure

Evaluation method	Method of education	Name of the unit/course or topic	Required Learning Outcomes	Hours	The week
Short questions	Lecture	**Mechanics of particle, Constraints , De Alembert's principle**		2	1
Short questions	Lecture	**Lagrange equations , examples**		2	2
Short questions	Lecture	**Hamilton's Principle, Derivation of Lagrange equations from Hamilton's principle.**		2	3
Short questions	Lecture	**Conservation of theorems and symmetry properties.**		2	4
Short questions	Lecture	**The two body central force problem, The equation of motion and first integral**		2	5
Short questions	Lecture	**The Virial theorem**		2	6
		Test 1		2	7
Short questions	Lecture	**Legender transformation and the Hamiltonian equations of motion**		2	8
Short questions	Lecture	**Cyclic coordinates and Routh's procedure**		2	9
Short questions	Lecture	**Conservation theorems and physical significance of the Hamiltonian.**		2	10
Short questions	Lecture	**Canonical transformation**		2	11
Short questions	Lecture	**Generating function of transformation**		2	12

Short questions	Lecture	**Examples of Canonical transformation**		2	13
Short questions	Lecture	**Examples of Canonical transformation**		2	14
		Tset 2		2	15

12. Infrastructure	
1-Classical Mechanics (3rd Edition) by .by Herbert Goldstein **2- Classical Mechanics by T. W. B. Kibble, Frank H. Berkshire**	Required readings : 1. Course Books 2. Other
• PowerPoint	Special Requirements
Attending scientific seminars	Social services (e.g. guest lectures, vocational training and field studies)

13. Acceptance	
	Prerequisites
10	Minimum number of students
14	The largest number of students

Course Description Form

Review the performance of higher education institutions ((Academic Program Review)

This course description provides a brief summary of the most important characteristics of the course and the learning outcomes expected of the student to achieve.
Proving whether he has made the most of the available learning opportunities. It must be linked to the description of program.

University Of Anbar	**1. Educational institution**
College of Education for Pure Sciences / Department of Physics	**2. University Department / Center**
Advanced quantum mechanics	**3. Course Name/Code**
Ph.D	**4. Programs in which it enters**
Presence	**5. Available Attendance Forms**
First Semester / 2023-2024	**6. Semester / Year**
3 hours	**7. Number of Credit Hours (Total)**
1Sept. 2023	**8. The history of preparation of this description**
9. Course Objectives:	
The student knows quantum mechanics in electromagnetic fields , Lorentz transformations , Angular momentum in electromagnetic fields in viewing of Q.M. and relativistic quantum mechanics equations	

10. Learning outcomes and methods of teaching, learning and evaluation

A. Knowledge and understanding

The student may understands the quantum mechanics in electromagnetic fields , Lorentz transformations , Angular momentum in electromagnetic fields in viewing of Q.M. and relativistic quantum mechanics equations

B. Subject-specific skills

Development of understand to students in modern mathematics , electromagnetics and quantum mechanics

- **Teaching and learning methods**

- Lecture, discussion, short reports, problem solving

- **Evaluation methods**

- Monthly test (essay and topical)
-Activity
-Short questions
-Reports
-Duties
-Final Exam

C. Thinking skills

- Ask various questions and brainstorm

-

- **Teaching and learning methods**

- Discussion, lecture, questioning

- **Evaluation methods**

1. Achievement Tests
2. Test methods (interview and observation)
3. Student feedback

D. General and transferable Skills (other skills related to employability and personal development).

Q.M. in EM fields needs to modern mathematical and understanding to all laws in EM an Electrodynamics also relativistic Q.M needs to know more on Relativity

11. Course Structure

Evaluation method	Method of education	Name of the unit/course or topic	Required Learning Outcomes	Hours	The week
Short questions	Lecture	**Description of the Classical Electromagnetic Field / Separation of Longitudinal and Transverse Components**		3	1
Short questions	Lecture	**Planar Electromagnetic Waves Hamilton Operator Electron in a Stationary Homogeneous Magnetic Field**		3	2
Short questions	Lecture	**Time -Dependent Perturbation Theory Perturbations due to Electromagnetic Radiation One-Photon Absorption and Emission in Atoms Two-Photon Processes**		3	3
Short questions	Lecture	**Many–Particle Systems Permutation Symmetry of Bosons and Fermions Operators of 2nd One– Quantization and Two–Particle Operator**		3	4
Short questions	Lecture	**Independent-Particle Models Self-Consistent Field Theory Self-Consistent Field**		3	5

		Algorithm Properties of the SCF Ground State Mean Field Theory for Macroscopic Systems			
		Test			6
Short questions	Lecture	**Relativistic Quantum Mechanics**		3	7
Short questions	Lecture	**Natural Representation of the Lorentz Group Scalars, 4–Vectors and Tensors Relativistic Electrodynamics Function Space Representation of Lorentz Group**		3	8
Short questions	Lecture	**Klein–Gordon Equation Klein–Gordon Equation for Particles in an Electromagnetic**		3	9
Short questions	Lecture	**The Dirac Equation Lorentz Invariance of the Dirac Equation Solutions of the Free Particle Dirac . Equation**		3	10
Short questions	Lecture	**Dirac Particles in Electromagnetic Field Spinor Formulation of Relativistic Quantum Mechanics The Lorentz Transformation of the Dirac Bispinor Relationship Between the Lie Groups SL(2,C) and SO(3,1**		3	11
Short questions	Lecture	**Spinor Spinors Tensors**		3	12
Short questions	Lecture	**Symmetry and Degeneracies Isospin and the SU(2) flavor symmetry**		3	13

Short questions	Lecture	**The Eightfold Way and the flavor SU(3) symmetry**		3	14
Short questions	Lecture	**Symmetry and Degeneracies Isospin and the SU(2) flavor symmetry**		3	15

12. Infrastructure	
1-Advanced Quantum Mechanics by Franz Schwabl **2- Quantum Mechanics by LEONARD I. SCHIFF** **3-Introduction to Quantum mechanics by D.J. Griffiths** **4-Quantum Mechanics by Eugen Merzbacher**	Required readings : 1. Course Books 2. Other
• PowerPoint	Special Requirements
Attending scientific seminars	Social services (e.g. guest lectures, vocational training and field studies)

13. Acceptance	
	Prerequisites
3	Minimum number of students
5	The largest number of students