مركز الاعتماد وضمان الجودة
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Course Syllabus

1	**Course title**	**Quantum Mechanics-2**	
2	**Course number**	**0342461**	
3	**Credit hours**	**3**	
	Contact hours (theory, practical)	**(3,0)**	
4	**Prerequisites/corequisites**	**0342361**	
5	**Program title**	**B.Sc.**	
6	**Program code**		
7	**Awarding institution**	**The University of Jordan**	
8	**School**	**School of Science**	
9	**Department**	**Department of Physics**	
10	**Course level**	**4th year -Bachelor**	
11	**Year of study and semester(s)**	**Second semester 2022/2023**	
12	**Other department(s) involved in teaching the course**	-	
13	**Main teaching language**	**English**	
14	**Delivery method**	☒Face to face learning ☐Blended ☐Fully online	
15	**Online platforms(s)**	☐Moodle ☒Microsoft Teams ☐Skype ☐Zoom ☐Others……	
16	**Issuing/Revision Date**	**25/2/2023**	

17 Course Coordinator:

Name: **Walaa Al Tamimi**	Contact hours: S, T, Th : 10.30 – 11.30
Office number: 3rd Floor-physics building	Phone number: 22047
Email: w.tamimi@ju.edu.jo	

18 Other instructors:

None

19 Course Description:

As stated in the approved study plan.

Time-independent perturbation theory (no degenerate and degenerate); fine structure of Hydrogen atom; Stark effect; Zeeman effect; time-dependent perturbation theory: emission and absorption of radiation; variational method; quantum theory of scattering: scattering amplitude and cross section, Born approximation; matrix quantum mechanics.

20 Course aims and outcomes:

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A- Aims:

Provide students with a good understanding of quantum mechanics concepts that enables them to apply it in other courses like nuclear physics, solid state physics, etc.

B- Students Learning Outcomes (SLOs):

For purposes of mapping the course SLOs to the physics program SLOs, at the successful completion of the physics program, graduates are expected to be able to:

SLO (1) Master professionally a broad set of knowledge concerning the fundamentals in the basic areas of physics: Quantum Mechanics, Classical Mechanics, Electrostatics and Magnetism, Thermal Physics, Optics, Theory of Special Relativity, Mathematical Physics, Electronics.

SLO (2) Apply knowledge of mathematics and fundamental concepts in the basic areas of physics to identify and solve physics related problems.

SLO (3) Utilize computers and available software in both data collections and data analysis.

SLO (4) Utilize standard laboratory equipment, modern instrumentation, and classical techniques to design and conduct experiments as well as to analyze and interpret data.

SLO (5) Develop a recognition of the need and ability to engage in life-long learning.

SLO (6) Demonstrate ability to use techniques, skills, and modern scientific tools necessary for professional practice.

SLO (7) Communicate clearly and effectively in both written and oral forms.

SLO (8) Apply proficiently team-work skills and employ team-based learning strategies.

SLO (9) Apply professional and ethical responsibility to society.

Upon successful completion of this course, students will be able to:

Program SLOs / Course SLOs	SLO (1)	SLO (2)	SLO (3)	SLO (4)	SLO (5)	SLO (6)	SLO (7)	SLO (8)	SLO (9)
1. solve the Schrodinger equation three dimensions	✓	✓							
2. Apply the three-dimensional Schrodinger equation to obtain the energy levels and eigenstates of the Hydrogen atom.	✓	✓				✓			
3. Use ladder operators and commutation relations to derive the orbital angular momentum quantum numbers and the magnetic quantum numbers, and their physical meaning.	✓	✓			✓	✓	✓	✓	
4. Compare and contrast between spin and angular momentum regarding their physical meaning and the quantum mechanical formalism that applies to each.	✓	✓				✓	✓	✓	
5. Differentiate between classical and quantum mechanical identical particles.	✓	✓							
6. Differentiate between fermions and bosons.	✓	✓				✓	✓		
7. Calculate the changes in the energy eigenvalues and the eigenfunctions when a quantum system is subjected to a time-independent perturbation	✓	✓	✓			✓	✓		
8. Use the relativistic and spin-orbit coupling corrections to calculate the fine structure in the Hydrogen atom.	✓	✓				✓	✓	✓	
9. Calculate the shifts in energy levels due to the Zeeman and Stark effects	✓	✓					✓	✓	
10. Apply the variational principle to simple problems.	✓	✓					✓		
11. Apply the WKB Approximation	✓	✓					✓	✓	
12. Differentiate between classical and quantum scattering	✓	✓				✓	✓		
13. Apply Born Approximation.	✓	✓					✓	✓	
14. Calculate transition probability up to second order corresponding to a time-dependent perturbation.	✓	✓					✓	✓	

21. Topic Outline and Schedule:

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Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1+2	1-6	solve the Schrodinger equation three dimensions	1	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 4
3+4	7-12	Solving the Schrodinger equation for the hydrogen atom	2+3	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 4
5	13-15	Angular momentum and spin formalism	4	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 4
6	16-18	Identical particles	5+6	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 5

7+8+9	19-27	a time-independent perturbation	7+8+9	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 7
10	28-30	Variational principle	10	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 8
11	31-33	WKB Approximation	11	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 9
12	34-36	Scattering	12	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 10

13	37-39	Born Approximation	13	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 10
14	40-42	Time-dependent perturbation	14	Face to Face	Lecture Room	Synchronous	Assignments+ Quizzes + Written Exams	Chapter 11

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
Assignment #1	5	Chapter 4	1-3	3rd Week	On campus
Quiz #1	5	Chapter 4	4	4th Week	On campus
Assignment #2	5	Chapters 7,8,9	7,8,9	10th Week	On campus
Midterm Exam	30	Chapter 4,5,7	5,6,7,8,9	12th Week	On campus
Quiz #2	5	Chapter 8	10	14th Week	On campus
Final Exam	50	Chapter 4,5,7,8,9,10, 11	1-14	15-6-2023	On campus

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23 Course Requirements

Students are directed and encouraged to use all possible resources:
a) use the internet as a learning source.
b) a series of short movies is promoted
c) students are encouraged to learn a suitable software package as a learning tool.

24 Course Policies:

A- Attendance policies:

No more than 15% of classes can be missed under any circumstances. The students are supposed to be on time for each session and will not be admitted after 10 minutes from the starting time.

B- Absences from exams and submitting assignments on time:

Assignments are only taken if submitted on time and no make ups for short quizzes.

C- Health and safety procedures:

The lectures are located in proper locations for best lecturing conditions.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

Any act of cheating or plagiarism is not tolerated and the students are clearly required to submit their own work.

E- Grading policy:

The grading for this course is divided into: Assignments 10%, Written Quizzes: 10%, Midterm Exam: 30%, Final Exam: 50%.

F- Available university services that support achievement in the course:

Textbook, computer, and internet access

25 References:

A- Required book(s), assigned reading and audio-visuals:

Introduction to Quantum Mechanics, by David Griffiths & Darrell Schroeter, 3rd edition, Cambridge University Press 2018, ISBN 978-1-107-18963-8 Hardback.

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B- Recommended books, materials, and media:

- References: any introductory book on a level comparable to our textbook.

26 Additional information:

Name of Course Coordinator: **Walaa Al Tamimi** ---Signature: Dr.W --Date: **February 25, 2023**----------
Head of Curriculum Committee/Department: ---------- Signature: ----------
Head of Department: ---------- Signature: ----------
Head of Curriculum Committee/Faculty: ---------- Signature: ----------
Dean: ---------- Signature: ----------