Kingdom of Saudi Arabia
The National Commission for Academic Accreditation & Assessment

T6. Course Specifications (CS)

Course title: Quantum Mechanics (2)

Course code: 23063324-3

Course Specifications

Institution: **Umm AL – Qura University**	Date : **10/3/1439**
College/Department : **Jamoum University College – Physics Department**	

A. Course Identification and General Information

1. Course title and code: **Quantum Mechanics (2) (code: 23063324-3)**
2. Credit hours: **3 hrs.**
3. Program(s) in which the course is offered. **BSc Physics**
(If general elective available in many programs indicate this rather than list programs)
4. Name of faculty member responsible for the course
One of the staff members
5. Level/year at which this course is offered: **3rd Year / Level 6**
6. Pre-requisites for this course (if any) : **Quantum Mechanics (1) (23063323-4)**
7. Co-requisites for this course (if any) : ---
8. Location if not on main campus: **Al-Jamoum**
9. Mode of Instruction (mark all that apply)

a. traditional classroom	✓	What percentage?	100%
b. blended (traditional and online)		What percentage?	
c. e-learning		What percentage?	
d. correspondence		What percentage?	
f. other		What percentage?	

Comments:

B Objectives

1. What is the main purpose for this course?

By the end of the course, students should understand each major concept of the following and be able to demonstrate their understanding in problems resolving as well as in applications in modern physics and in this field:

- Method of operators (lowering and rising operators, ...).
- Addition of angular momenta and spin.
- Matrix representation.
- Approximation methods to solve Schrödinger Equation.
- Emission and Absorption of Radiation.
- Scattering theory.

2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)

1- Outlines of the physical laws, principles and the associated proofs.
2. Highlighting the day life applications whenever exist.
3. Encourage the students to see more details in the international websites and reference books in the library.
4- Encourage the student to build an example of different experiments related to the course.
5- Frequently check for the latest discovery in science.

C. Course Description (Note: General description in the form used in Bulletin or handbook)

Course Description:

1 Topics to be Covered

Topics	No of Weeks	Contact hours
❖ **Review of Quantum Mechanics 1** • Postulates. • Wave Mechanics and Schrodinger's Equation. • Operator Methods. • Bound and Unbound states in one-dimension. • Quantum Mechanics in more than one-dimension. • Matrix Mechanics. • Angular Momentum, Commutation Relations. • Spin; Spin Representation and Pauli matrices. • Addition of angular Momenta and spin.	2	6
❖ **Time –Independent Perturbation Theory**	3	9

• Perturbation Series; First and Second Order Expansion. • Degenerate Perturbation Theory. • The Fine Structure of Hydrogen. • The Stark Effect. • The Zeeman Effect.		
❖ **Variational Principle** • Theory • The Ground State of Helium.	**2**	**6**
❖ **The WKB Approximation** • The Classical Region. • Tunneling.	**1**	**3**
❖ **Time-Dependent Perturbation Theory** • Two- Level Systems: The Perturbed System, Time-Dependent Perturbation Theory, Sinusoidal Perturbations. • Emission and Absorption of Radiation, Absorption, Stimulated Emission, and Spontaneous Emission, Incoheret Perturbations. • Spontaneous Emission: Einstein's A and B coefficients, The Lifetime of an Excited State, Selection Rules.	**4**	**12**
❖ **Scattering** • Introduction. • Partial Wave Analysis. The Born Approximation.	**2**	**6**
	14 weeks	**42 hrs**

2. Course components (total contact hours and credits per semester):

	Lecture	Tutorial	Laboratory or Studio	Practical	Other:	Total
Contact Hours	**42**				**28**	**70**
Credit	**3**					

3. Additional private study/learning hours expected for students per week. 4

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy

On the table below are the five NQF Learning Domains, numbered in the left column.
First, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table).
Second, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes.
Third, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
1.1	Define the physical quantities, physical phenomena, and basic principles.	1- Demonstrating the basic principles through lectures. 2. Discussing phenomena with illustrating pictures and diagrams. 3. Lecturing method: Board, Power point. 4. Discussions 5. Brain storming 6. Start each chapter by general idea and the benefit of it.	Solve some example during the lecture. Discussions during the lectures Exams: a) Quizzes (E-learning) b) Short exams (mid- term exams) c) Long exams (final) d) Oral exams .
1.2	Describe the physical laws and quantities using mathematics		
2.0	**Cognitive Skills**		
2.1	Apply the laws of physics to calculate some quantities.	1. Preparing main outlines for teaching. 2. Following some proofs. 3. Define duties for each chapter	1. Exams (Midterm, final, quizzes) 2. Asking about physical laws previously taught
2.2	Solve problems in physics by using suitable mathematics.		
2.3	Analyse and interpret quantitative results.		

2.4	Apply physical principle on day life phenomena.	4. Encourage the student to look for the information in different references. 5. Ask the student to attend lectures for practice solving problem.	3. Writing reports on selected parts of the course. 4. Discussions of how to simplify or analyze some phenomena.
2.5	Derive the physical laws and formulas.		
3.0	**Interpersonal Skills & Responsibility**		
3.1	Show responsibility for self-learning to be aware with recent developments in physics	• Search through the internet and the library. • Small group discussion. • Enhance self-learning skills. • Develop their interest in Science through : (lab work, visits to scientific and research institutes).	• Evaluate the efforts of each student in preparing the report. • Evaluate the scientific reports. • Evaluate the team work in lab and small groups. • Evaluation of students presentations.
3.2	Work effectively in groups and exercise leadership when appropriate.		
4.0	**Communication, Information Technology, Numerical**		
4.1	Communicate effectively in oral and written form.	• Incorporating the use and utilization of computer, software, network and multimedia through courses • preparing a report on some topics related to the course depending on web sites	• Evaluating the scientific reports. • Evaluating activities and homework
4.2	Collect and classify the material for the course.		
4.3	Use basic physics terminology in English.		
4.4	Acquire the skills to use the internet communicates tools.		
5.0	**Psychomotor (NA)**		

5. Map course LOs with the program LOs. (Place course LO #s in the left column and program LO #s across the top.)																
Course LOs #	**Program Learning Outcomes (Use Program LO Code #s provided in the Program Specifications)**															
	1.1	**1.2**	**1.3**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**3.1**	**3.2**	**4.1**	**4.2**	**4.3**	**4.4**	**5.1**	**5.2**
1.1	✓															
1.2		✓														
1.3																
2.1				✓												
2.2					✓											
2.3						✓										
2.4							✓									
2.5								✓								
3.1									✓							
3.2										✓						
4.1											✓					
4.2												✓				
4.3													✓			
4.4														✓		
5.1																
5.2																

6. Schedule of Assessment Tasks for Students During the Semester			
	Assessment task (e.g. essay, test, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	Exercises & Home works	All weeks	10 %
2	Participation	All weeks	10 %
3	In-Class Problem Solving	All weeks	10 %
4	Midterm 1	6th week	10 %
5	Midterm 2	12th week	10 %
6	Final Exam	16th week	50 %

D. Student Academic Counseling and Support

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)
Each student will supervise by academic adviser in physics Department and the time table for academic advice were given to the student each semester. (4hrs per week)

E Learning Resources

1. List Required Textbooks
David J. Griffiths "Introduction to Quantum Mechanics", Pearson Prentice Hall, New York, (2005).
S. Gasiorowicz, "Quantum Mechanics", John Wiley & Sons, Inc., 3rd Ed. (2003).

2. List Essential References Materials (Journals, Reports, etc.)

3. List Recommended Textbooks and Reference Material (Journals, Reports, etc)
Nouredine Zettili, "Quantum Mechanics: Concepts and Applications", John Wiley & Sons, Inc. (2001).

4. List Electronic Materials, Web Sites, Facebook, Twitter, etc.
www.uqu.sa/feothman

5. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

Indicate requirements for the course, including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access etc.)

1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)
Classroom for 40 students
Library

2. Computing resources (AV, data show, Smart Board, software, etc.)
Computer room
Data show

3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)
Each Classroom requires a data show, and double layer white board.

G Course Evaluation and Improvement Processes

1 Strategies for Obtaining Student Feedback on Effectiveness of Teaching

- Evaluating the instructor by the student using questionnaires.
- Following up the progress of students in the course.
- Evaluating the progress of student by projects.

2 Other Strategies for Evaluation of Teaching by the Instructor or by the Department

- Revision of student answer paper by another staff member.
- Analysis the grades of students.

3 Processes for Improvement of Teaching

- Strategies are modified each term according to the student feedback.

4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution)

- The instructors of the course are checking together and put a unique process of evaluation.
- Check marking of a sample of papers by others in the department.
- Feedback evaluation of teaching from independent organization.
- Independent evaluation by another instructor that give the same course in another faculty.
- Evaluation by the accreditation committee in the university.

5 Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement.

1- The following points may help to get the course effectiveness
   - Student evaluation
   - Course report
   - Program report
   - Program Self study
2- According to point 1 the plan of improvement should be given.