المركز الوطني للتقويم والاعتماد الاكاديمي
National Center for Academic Accreditation and Evaluation

ATTACHMENT 5.

T6. COURSE SPECIFICATIONS (CS)

هيئة تقويم التعليم
Education Evaluation Commission

Course Specifications

Institution: University of Tabuk	Date:	18/4/2019
Faculty/Department : Science/Physics		

A. Course Identification and General Information

1. Course title and code:
   Quantum Mechanics I, PHYS354
2. Credit hours: 3
3. Program(s) in which the course is offered.
(If general elective available in many programs indicate this rather than list programs)
Bachelor of Science
4. Name of faculty member responsible for the course
Rachid Ayad
5. Level/year at which this course is offered: 6/3
6. Pre-requisites for this course (if any):
PHYS342 and PHYS251
7. Co-requisites for this course (if any): none
8. Location if not on main campus: Main campus
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?

The primary emphasis is on developing basic understanding of QM topics and its applications starting in the beginning of the 20th century. It is the first part of the QM courses: Phys354 (QM I) and Phys455 (QM II). The student will, first, be acquainted with the mathematic formalism of QM (called Dirac math formalism of QM) that will her/him to study QM phenomena in an easy way. Then, the students will be able to master how to solve Schrodinger equation and its applications in the physical phenomenon like the alpha decay of nucleus (Schrodinger equation with Barrier Potential). The student will also use his knowledge of solving Schrodinger equation with a Barrier potential to understand the basic physical mechanism of the Atomic Force Microscope (AFM). He/She will extend her/his knowledge about QM to the important notion of angular momentum as an overall quantum theory of angular momentum that can be applied to: orbital momentum, spin, isospin. Means all the above angular momentum applications use the same mathematical formalism of Quantum angular momentum as an overall theory of Quantum angular momentum as mentioned above. The angular momentum is also used to study QM phenomena like Zeeman effect (effect on atoms in presence of a magnetic field), and also we use spin notion to study Nuclear Magnetic Resonance (NMR) phenomenon used in Nuclear Magnetic Imaging (NMI) medical instruments.

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)

The course does not need further updates.

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

Course Description:

The course covers: Basic ideas of wave function, probability density, Operators, Schrodinger equation in one, two and three dimensions, step potential, barrier potentials, particle in a box and the harmonic oscillator, solution of the Schrodinger equation for the hydrogen like atom, angular momentum, spin, and spin orbit interaction.

1. Topics to be Covered

List of Topics	No. of Weeks	Contact hours
Review of modern physics I and Modern Physics II	1	3
Basic ideas of wave function	2	3

Mathematical Formalism of QM: Dirac formalism I and operators	3	3
Mathematical Formalism of QM: Dirac formalism II and operators	4	3
Density matrix operator	5	3
Schrodinger equation in 1D, 2D, and 3D	6	3
Solution of Schrodinger equation: particle in a box and Midterm1	7	3
Solution of Schrodinger equation: step potential	8	3
Solution of Schrodinger equation: barrier potentials	9	3
Solution of Schrodinger equation: harmonic oscillator	10	3
Solution of Schrodinger equation: the hydrogen like atom I and Midterm2	11	3
Solution of Schrodinger equation: the hydrogen like atom II	12	3
Angular momentum	13	3
Spin orbit interaction	14	3

2. Course components (total contact hours and credits per semester): 45

		Lecture	Tutorial	Laboratory/ Studio	Practical	Midterm exams	Total
Contact Hours	Planed	42				3	45
	Actual	42				3	45
Credit	Planed	3					3
	Actual	3					3

3. Additional private study/learning hours expected for students per week: **20**

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	Be able to describe the theoretical basis of the fundamental concepts of various QM topics covered in the course	- Introductory lecture about the significance of the course and the topics to be covered - Learn to use the library in the self-learning fashion - Students are assigned home-work problems - Solving selected home assigned problems from each text book chapter. - On-line web-based learning	- Homework exams - Written exams
1.2			
2.0	**Cognitive Skills**		
2.1	Be able to apply mathematical concepts, strategies and procedures to solve problems and eventually perform research and Lab experiments, in various fields of QM, and draw conclusions to build up ideas for further problems solving and applications.	- Introductory lecture about the significance of the course and the topics to be covered - Learn to use the library in the self-learning fashion - Students are assigned home-work problems - Solving selected home assigned problems from each text book chapter. - On-line web-based learning	- Homework exams - Written exams
2.2	Be able to communicate effectively with a range of audiences in particular with students, teacher, and with colleagues in R&D groups, and general audience.		
3.0	**Interpersonal Skills & Responsibility**		
3.1	Directing the student to self-learning and greater knowledge in the field of the course.		-Presentations

3.2	Encouraging students to communicate among themselves under instructor guidance.	-Assign students projects on topics related to the subject - Give students critical thinking questions	-Participation
4.0	**Communication, Information Technology, Numerical**		
4.1	None		
4.2			
5.0	**Psychomotor**		
5.1	None		
5.2			

5. Schedule of Assessment Tasks for Students During the Semester

	Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	HW, Quizzes and participation	Over all the semester	10%
2	Midterm exam 1	6	25%
3	Midterm exam 2	11	25%
4	Final exam	16	40%

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)

Students are split in groups and a Faculty member is assigned to a group as adviser. The adviser is responsible of:

1) Providing career guidance for students
2) Inform Students of Faculty and University Policies
3) Monitor Student Performance.
4) Conducting Orientation Sessions.
5) Informing Students of available Resources (library, classrooms, Labs, ….)

The course teacher has, as well, definite office hours to be available for student counseling and problems solving. The teacher uses every way possible to let students know when he hold office hours; He post them on his door office, mention them on the course syllabus, post them on the course website, and announce them in class.

E Learning Resources

1. List Required Textbooks

Introduction to quantum mechanics by David J. Griffiths , 2th edition, Prentice Hall, Inc

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

a- Student difficulties in learning quantum mechanics
D. Johnston , K. Crawford & P. R. Fletcher
https://www.tandfonline.com/doi/abs/10.1080/0950069980200404

b- Teaching quantum mechanics on an introductory level
https://aapt.scitation.org/doi/10.1119/1.1435346

c- Understanding Student Difficulties in First Year Quantum Mechanics Courses
L. Koopman∗, W.H. Kaper, A.L. Ellermeijer
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.581.5436&rep=rep1&type=pdf

3. List Electronic Materials, Web Sites, Facebook, Twitter, etc.

a- MIT Open Courseware: https://ocw.mit.edu/courses/physics/

b- Many youtube channels and videos like: Lecture 1 | Modern Physics: Quantum Mechanics (Stanford U), by Leonard Susskind (many lectures) https://www.youtube.com/watch?v=JzhlfbWBuQ8
4. Other learning material such as computer-based programs/CD, professional standards or regulations and software.

F. Facilities Required

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.) Smart Classrooms
2. Technology resources (AV, data show, Smart Board, software, etc.) - Data show. - Internet
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list)

G Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching - Regular evaluation of the course teaching to identify the weak areas - Performance appraisal form filled up by students to show level of fulfillment - Confidential completion of standard course evaluation questionnaire
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department - A regular statistical review and analysis of the students' achievement in the department. - Prepare a questionnaire which should be filled by the students at the end of the term. Questionnaires should be analyzed and carefully studied.
3. Processes for Improvement of Teaching - Provide training and workshop opportunities for the teaching staff to improve their teaching strategies. - Form committees to follow up progress and work on improvement. - Provide opportunities to improve academic courses and research through conferences. - Provide the teaching staff members with all the references and electronic resources. - Updating teaching strategies through reading new articles about related topics to the course - Improve relations between instructor and students

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 department is working towards Standardization of exams in case of a multi-section course. The department is scheduling regular visits of external examiners to evaluate the teaching at overall and to verify standardization of student's assessment, as well its alignment with international quality assurance guidelines. The quality assurance deanship at the faculty and at the university level have also the task to ensure that students' assessment is aligned with local and international curriculum.

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

- Student's feedback on the quality of the course.
- Consulting other faculty members or collaborator in overseas universities for their views on the method of quality of improvement
- Check other universities teaching websites
- Improve course syllabus following syllabus templates from standard universities.
- Create a specialized committee from the department to review the progress of teaching and update the resources
- Consult distinguished students and discuss with them how to improve Lecturing issues.

Name of Course Instructor: Rachid Ayad

Signature: *Rachid Ayad* Date Specification Completed: 18/4/2019

Program Coordinator: Dr. Fahad Alharbi
Signature: *Dr. Fahad Alharbi* Date Received: 19/4/2019