

ROWAN UNIVERSITY CURRICULUM PROPOSAL

1967-542

2

PROPOSAL TITLE: Quantum Mechanics I (graduate)

CHECK APPROPRIATE: UNDERGRADUATE GRADUATE SEMESTER HOURS

SPONSOR(S): 4 Ling + ^{Dept} Chem + Phys

DEPARTMENT/TELEPHONE # Chem + Phys -4855

CHECK ONE: COURSE MINOR PROGRAM CONCENTRATION SPECIALIZATION
 ACHIEVEMENT CERTIFICATE CERTIFICATION PROGRAM MAJOR PROGRAM

<p>Step #1 (Department)</p> <p><input checked="" type="checkbox"/> Approved (Date) <u>9/12/97</u></p> <p><input type="checkbox"/> Not Approved (Date)</p> <p><u>P.J. Neeland (Chair)</u> Dept. Curriculum Chr.</p> <p><u>9/12/97</u> Reviewed (Date)</p> <p><u>P.J. Neeland (Chair)</u> Dept. Chr.</p>	<p>Step #2 (Receipt)</p> <p>SCC# <u>97-98-37</u></p> <p><u>10.9.97</u> Date Received Senate</p> <p><u>[Signature]</u> Senate Curriculum Chr.</p>	<p>Step #3 (School)</p> <p>Reviewed Date: <u>10/20/97</u></p> <p><input type="checkbox"/> Recommend to Approved</p> <p><input type="checkbox"/> Recommend NOT to Approve</p> <p>Forward for Open Hearing:</p> <p><input checked="" type="checkbox"/> WITHOUT Reservations</p> <p><input type="checkbox"/> WITH Reservations:</p> <p>Comments: <u>Pre-req updated; project specified</u></p> <p><u>[Signature]</u> School Committee Chr.</p>
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Step #4 (Academic Dean): Recommended NOT Recommended Conditionally Recommended (See Comments)

Comments:

Dean Signature/Date: [Signature]

Step #5 (Senate Curriculum Committee): Open Hearing Date: 11-19-97 Approved by Curriculum Committee Date 11-19-97

Returned to Sponsor(s) for the following reason:

Step #6 (Senate) Date announced/voted on at Senate 11-23-97 If voted on: Approved NOT Approved

Date forwarded to Executive Vice President/Provost 11-23-97

Senate Curriculum Committee chair Signature/Date: _____

Step #7 (Executive Vice President/Provost): Date Received 1/14/98

Approved

NOT Approved If no, reasons are as follows:

Student Credit Hours 2

Faculty Load Hours 3

Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date) _____

Executive Vice President/Provost Signature [Signature]

Registrar

Date Approved Course Description Received 15 Jan 98

Hegis Taxonomy and Course Number Assigned 1962.542

Date/Signature of Registrar [Signature]

Notification Forward:

Senate Curriculum Committee Chairperson

Department Chairpersons

Academic Dean(s)

Registrar

Sponsor(s)

*Transmitted
1/23/98*

Quantum Mechanics II

1. Details:

Course Title:	Quantum Mechanics II
Sponsors:	Hong Yuan Ling, Department of Chemistry and Physics
Credit Hours:	3 s.h.
Course Level:	Graduate
Curricular Effect:	Elective
Prerequisites:	Quantum Mechanics I or permission of instructor.
Time of Implementation:	Fall 98
Adequacy of Resources:	Present faculty, facilities and library holdings are adequate. However, we will make further efforts to enhance the library collections in the area of quantum mechanics.

2. Rationale:

Quantum Mechanics I and II are proposed to replace our present 4 credit hours Quantum Physics(1902.389). Quantum Mechanics solves the problems in where Newtonian (classical) physics fails. Quantum Mechanics is extremely difficult conceptually. It views the world in a way very different from our conventional thinking. It deals with matters on a scale that is beyond the reach by our everyday life. Quantum Mechanics is also notoriously difficult mathematically. It requires sophisticated and diverse mathematical skills ranging from partial differential equations to linear algebra. Our past experience with Quantum Physics indicates that it is an overwhelmingly difficult task for an average student to face all these challenges in one semester. The study of physics is a logical progression. If this course can be taught in two semesters, our students will have time to absorb the material in a reasonable pace. We believe that dividing this course into two semesters is in the best interest of our student learning.

Quantum Mechanics I will focus on the concepts and applications that demonstrate typical approaches in quantum mechanics but involve minimum mathematical complexities. One dimensional bound-state and scattering problems will be discussed in great detail; Hydrogen model (in the absence of the spin-orbital coupling) is analyzed as a guideline to the understanding of the periodic table; the study of Hilbert space and spin will remain in the introductory level. Quantum Mechanics II will place emphasis on the concept of Hilbert space and the applications of matrix method and operator algebra. Some of the topics are addition of angular momentum, spin-orbit coupling, perturbation theories, and scattering.

Quantum Mechanics is extremely successful in describing the behavior of matter on a microscopic scale. Its importance to our society has become even more evident since much new technology is based on the principles of Quantum Mechanics. We believe that Quantum Mechanics is an integral part of the curriculum in the study of physics. Graduate students who are interested in physics study are strongly advised to take both Quantum Mechanics I and II.

3. Essence of the course:

(a) Objectives:

After taking this course students will be able to:

- Have a deep understanding of the foundation of the Quantum mechanics.
- Solve problems with matrix method.
- Know how to perform the spin and angular momentum addition.
- Understand the spectra of atoms more complex than the Hydrogen atom.
- Apply perturbation methods to solve practical problems.

(b) Topical Outline:

Possible textbooks:

Introduction to Quantum Mechanics by David J. Griffiths.

Principles of Quantum Mechanics by Hans C. Ohanian.

The course will include the following selected topics:

1. Formalism of Quantum Mechanics
Hilbert space, operator matrix, commutator relations, eigenvalue and eigenvectors.
2. Particles in three dimensions and angular momentum
Hydrogen Atom, spins, angular momentum addition.
3. Identical particles
Two-particle systems, atoms, solids, and quantum statistical mechanics.
4. Time -independent perturbation theory
Nondegenerate perturbation theory, degenerate perturbation theory, the finite structure of Hydrogen, the Zeeman effect, Hyperfine splitting
5. Time-dependent perturbation theory
Two-level systems, emission and absorption of radiation, spontaneous emission
6. Scattering
Partial wave analysis, the Born approximation.

(c) Evaluation Procedures:

Students will be evaluated by homework, exams, class participation, a graduate research paper or a laboratory project, and a final.

(d) Course Evaluations:

The departmental course evaluation form will be used at the end of the course.

4. Consultations

Department of Chemistry and Physics

Catalog Description

Quantum Mechanics II (1902. 5 × ×)

3 s.h

(Prerequisite: Quantum Mechanics I or permission of instructor)

This course is a continuation of Quantum Mechanics I. Students will learn more advanced concepts and problems in quantum mechanics. Topics selected for study include the formalism of quantum mechanics, particles in three-dimensions, spin and angular momentum, quantum statistical mechanics, time-independent perturbation theory, time-dependent perturbation theory, and scattering. Some topics may overlap with the ones in Quantum Mechanics I, but are taught at a higher level. The requirements of this course include a graduate research paper or a laboratory project.