ROWAN UNIVERSITY CURRICULUM PROPOSAL

1967-402

PROPOSAL TITLE: Quantum Mechanics II (UG)

CHECK APPROPRIATE: X UNDERGRADUATE ___ GRADUATE 3 SEMESTER HOURS

SPONSOR(S): H. Lang + Dept Chem + Phys

DEPARTMENT/TELEPHONE #

CHECK ONE: X COURSE __MINOR PROGRAM __CONCENTRATION __SPECIALIZATION __ACHIEVEMENT CERTIFICATE __CERTIFICATION PROGRAM __MAJOR PROGRAM

Step #1 (Department)	Step #2 (Receipt)	Step #3 (School)
X Approved (Date) 9/12/97	SCC# 97-98-27	Reviewed Date: 10/20/97
___ Not Approved (Date)		___ Recommend to Approved
		___ Recommend NOT to Approve
[signature] (Phys) 9/12/97 Dept. Curriculum Chr.	10-9-97 Date Received Senate	Forward for Open Hearing:
		X WITHOUT Reservations
9/12/97 Reviewed (Date)		___ WITH Reservations:
		Comments: Pre-reqs updated
[signature] (Phys) Dept. Chr.	[signature] Senate Curriculum Chr.	[signature] School Committee Chr.

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 1-25-98 If voted on: ___Approved ___NOT Approved

Date forwarded to Executive Vice President/Provost [illegible]

Senate Curriculum Committee chair Signature/Date: ______

Step #7 (Executive Vice President/Provost): Date Received DEC 1997

___ Approved

___ NOT Approved If no, reasons are as follows:

Student Credit Hours _____

Faculty Load Hours _____

Equalized Credit Hours _____

Official Copy & Approval Sheet Filed (Date) _____

Executive Vice President/Provost Signature _____

Registrar

Date Approved Course Description Received 15 Jan 98

Hegis Taxonomy and Course Number Assigned 1902 402

Date/Signature of Registrar Bill Kelly

Notification Forward:

✓ Senate Curriculum Committee Chairperson

✓ Department Chairpersons

✓ Academic Dean(s)

✓ Registrar

✓ Sponsor(s)

Transmittal 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:	Undergraduate: Junior/Senior
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.

2. Rationale:

Quantum Mechanics I and II are proposed to replace our present 4 credit hours Quantum Physics(1902.389). Quantum Mechanics provides a framework for solving problems where Newtonian (classical) physics fails. Quantum Mechanics is often counterintuitive and can be conceptually difficult. It views the world in a way very different from our conventional thinking. It deals with size scales much smaller than we encounter in our everyday life. Quantum Mechanics can be 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, each chapter and topic building upon the framework developed to that point. If this course can be taught in two semesters, our students will have time to absorb the material at a reasonable pace. We believe that dividing this course into two semesters will help our students to learn and retain the important concepts of quantum mechanics.

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. Quantum Mechanics is an integral part of any curriculum for the study of physics. Quantum Mechanics I will be required of every physics major. Quantum Mechanics II will be offered as a physics elective. Majors are strongly advised to take the course.

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, 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

6. Catalog Description

Quantum Mechanics II (1902.3××) 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.