STATE UNIVERSITY OF NEW YORK !
COLLEGE OF TECHNOLOGY !
CANTON, NEW YORK !

MASTER SYLLABUS

COURSE NUMBER – COURSE NAME
PHYS 420 - INTRODUCTION TO QUANTUM MECHNICS

Created by: Feng Hong

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Canino School of Engineering Technology !

Department: PHYSICS !

Semester/Year: FALL/2018 !

A. **TITLE**: Introduction to Quantum Mechanics

B. **COURSE NUMBER:** PHYS 420

C. **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

 # Credit Hours: 3
 # Lecture Hours: 3 **per week**
 # Lab Hours: **per week**
Other: **per week**

Course Length: 15 **Weeks**

D. **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

E. **GER CATEGORY: None:** ☒ **Yes:** GER !
***If course satisfies more than one*:** GER !

F. **SEMESTER(S) OFFERED: Fall** ☒ **Spring** ☐ **Fall & Spring** ☐

G. **COURSE DESCRIPTION:**

This course is a senior-level introduction to the theory and formalism of non-relativistic quantum mechanics and its applications. This course provides the background with which to understand and meet the challenge of new applications of quantum mechanics. Principles of quantum mechanics and some mathematical techniques of solving quantum mechanical problems are examined.

H. **PRE-REQUISITES: None** ☐ **Yes** ☒ **If yes, list below:**

PHYS 132(University Physics II); MATH 162(Calculus II), or permission of instructor

CO-REQUISITES: None ☒ **Yes** ☐ **If yes, list below:**

I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

Course Student Learning Outcome [SLO]	***Program Student Learning Outcome [PSLO]***	***GER*** *[If Applicable]*	***ISLO & SUBSETS***	
State the four postulates of quantum mechanics and Recall the relationship between eigenvalues, expectation values and experimental measurements	N/A	N/A	2-Crit Think 1-Comm Skills ISLO	CA W Subsets Subsets
Recall the definitions of introductory quantum mechanical terms such as wave functions, eigenstate, stationary state, angular momentum, parity and compatible observables	N/A	N/A	2-Crit Think 1-Comm Skills ISLO	PS W Subsets Subsets
d. Solve quantum mechanical problems involving the Schrodinger equation for simple 1-D systems	N/A	N/A	2-Crit Think 1-Comm Skills ISLO	PS W Subsets Subsets
Determine if a physical quantity is a constant of motion	N/A	N/A	2-Crit Think 1-Comm Skills ISLO	PS W Subsets Subsets
Solve quantum mechanical problems involving the addition of generalized angular momentum including transforming between the coupled and un-coupled representations	N/A	N/A	2-Crit Think 1-Comm Skills ISLO	PS W Subsets Subsets

KEY	**Institutional Student Learning Outcomes [ISLO 1 – 5]**
ISLO #	**ISLO & Subsets**
1	**Communication Skills** Oral [O], Written [W]
2	**Critical Thinking** *Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]*
3	**Foundational Skills** *Information Management [IM], Quantitative Lit,/Reasoning [QTR]*
4	**Social Responsibility** *Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]*
5	**Industry, Professional, Discipline Specific Knowledge and Skills**

*Include program objectives if applicable. Please consult with Program Coordinator !

J. ! APPLIED LEARNING COMPONENT: Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

K. ! TEXTS:

Goswami, Amit (2005). Quantum Mechanics. Dubuque, Iowa: Wm. C. Brown Publishers.

L. ! REFERENCES:

None

M. ! EQUIPMENT: None ☐ **Needed:** Technology enhanced classroom

N. ! GRADING METHOD: A-F

O. ! SUGGESTED MEASUREMENT CRITERIA/METHODS:

- **! Exams**
- **! Quizzes**
- **! Homework**
- **! Projects**

P. DETAILED COURSE OUTLINE:

I. ! Experimental Basis of Quantum Mechanics
Brief summary of the experimental results that lead to and verify quantum mechanics including: Thermal Radiation, Photo-electric Effect, Compton Effect, Wave-like Properties of Particles-Electron Diffraction, Uncertainty Principle, and Bohr's Model of the Atom.

II. ! Formalism of Quantum Mechanics
- **A. ! Wave Functions: The Basics of Probability Theory.**
- **B. ! Time-independent and Time-dependent Schrodinger's Equation.**
- **C. ! Operators and Expectation values.**
- **D. ! Wave-particle duality, complementarity, and the postulates of quantum mechanics.**
- **E. ! Hermitian operators, eigenvalue equations, commutators, uncertainty relations, and conservation laws.**

III. ! One Dimensional Quantum Systems
- **A. ! Wave packets.**

B. Solutions of Schrodinger's Equation for various potentials including the simple harmonic oscillator, infinite and finite potential wells, tunneling through a barrier, and applications.

IV. ! Hydrogen Atom

A. The experimental results leading to and verifying quantum mechanics.

B. Operators in quantum mechanics are introduced.

V. ! Selected Applications

Atoms, lasers, molecules, semiconductors, and transistors.

Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐