MASTER SYLLABUS

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

Created by: Feng Hong
Updated by: Feng Hong

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:

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

**KEY**

<table>
<thead>
<tr>
<th>ISLO #</th>
<th>Institutional Student Learning Outcomes [ISLO 1 – 5]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Communication Skills</td>
</tr>
<tr>
<td></td>
<td>Oral [O], Written [W]</td>
</tr>
<tr>
<td>2</td>
<td>Critical Thinking</td>
</tr>
<tr>
<td>3</td>
<td>Foundational Skills</td>
</tr>
<tr>
<td>4</td>
<td>Social Responsibility</td>
</tr>
<tr>
<td>5</td>
<td>Industry, Professional, Discipline Specific Knowledge and Skills</td>
</tr>
</tbody>
</table>

*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:**


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**


II. **Formalism of Quantum Mechanics**

B. Time-independent and Time-dependent Schrödinger'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. LABORATORY OUTLINE: None ☒ Yes ☐