College of San Mateo
Official Course Outline

1. **COURSE ID:** PHYS 271 **TITLE:** Quantum Mechanics Supplement
   Units: 1.0 units **Hours/Semester:** 16.0-18.0 Lecture hours; and 32.0-36.0 Homework hours
   Method of Grading: Letter Grade Only
   Prerequisite: PHYS 260, and Completion of or concurrent enrollment in PHYS 270 and Completion of or concurrent enrollment in MATH 275, and Completion of or concurrent enrollment in MATH 270

2. **COURSE DESIGNATION:**
   Degree Credit
   Transfer credit: none

3. **COURSE DESCRIPTIONS:**
   Catalog Description:
   This course will further explore introductory quantum mechanics for students considering majoring in Physics, Chemistry, or certain fields of Engineering.

4. **STUDENT LEARNING OUTCOME(S) (SLO'S):**
   Upon successful completion of this course, a student will meet the following outcomes:
   1. Use wave packets to describe localized particles and to explain the Heisenberg Uncertainty Principle.
   2. Solve the Schrodinger Equation in one and three dimensions for simple potential energy functions.
   3. Define, calculate, and explain the significance of expectation values.
   4. Use energy operators, momentum operators and other operators to extract information from wavefunctions and to compute expectation values.
   5. Write normalized mixed energy states and use those states to calculate probabilities and expectation values.

5. **SPECIFIC INSTRUCTIONAL OBJECTIVES:**
   Upon successful completion of this course, a student will be able to:
   1. Use wave packets to describe localized particles and to explain the Heisenberg Uncertainty Principle.
   2. Solve the Schrodinger Equation in one and three dimensions for simple potential energy functions.
   3. Define, calculate, and explain the significance of expectation values.
   4. Use energy operators, momentum operators and other operators to extract information from wavefunctions and to compute expectation values.
   5. Write normalized mixed energy states and use those states to calculate probabilities and expectation values.

6. **COURSE CONTENT:**
   Lecture Content:
   1. Particle Waves
      A. Particle Wavelengths
      B. Complex notation for waves
      C. Wave Packets and the Uncertainty Principle
   2. The Schrodinger Equation in One Dimension
      A. Time-Dependent and Time-Independent Wave Functions
      B. Solving for Wavenfunctions in Square Well Potential (Infinite and Finite)
      C. Operators and Expectation Values
      D. Solving for Wavefunctions in the Simple Harmonic Oscillator Potential
      E. Potential Barriers - Reflection, Transmission and Tunneling
   3. The Schrodinger Equation in Three Dimensions
      A. Particle in a Three Dimensional Well
      B. Solving for the Wavefunctions in the Hydrogen Atom
      C. The Schrodinger Equation for Two or More Particles
   4. Molecular Structure and Spectra
      A. Molecular Bonds
      B. Bonding and Antibonding Orbitals
      C. Energy Levels and Spectra in Diatomic Molecules
   5. Statistical and Solid State Physics
      A. Explanation of the Deviation from the Equipartition Theorem
      B. Wavefunctions in Crystal Lattices

C. Free-Electron Gas in Metals

7. **REPRESENTATIVE METHODS OF INSTRUCTION:**
Typical methods of instruction may include:
   A. Lecture
   B. Activity
   C. Discussion
   D. Other (Specify): Group Work

8. **REPRESENTATIVE ASSIGNMENTS**
Representative assignments in this course may include, but are not limited to the following:
Writing Assignments:
Solving textbook (or similar) problems after each lecture. Problems are of varying difficulty and are completed by students to help further their understanding of the concepts and to learn how physics formulas and mathematics are used to apply the concepts to specific situations.

The problems require critical thinking to determine what principles apply to the problem and may require mathematical techniques from algebra, single variable and multivariable calculus, linear algebra, and differential equations.
Reading Assignments:
Weekly text reading assignments.

9. **REPRESENTATIVE METHODS OF EVALUATION**
Representative methods of evaluation may include:
   A. Class Participation
   B. Exams/Tests
   C. Group Projects
   D. Homework
   E. Quizzes

10. **REPRESENTATIVE TEXT(S):**
Possible textbooks include:
   A. Taylor, J. R., Zafoiratos, C. D. and Dubson, M. A.. *Modern Physics for Scientists and Engineers*, 2nd ed. University Science Books, 2014
   B. Tipler, P. A. and Llewellyn, R.. *Modern Physics*, 6th ed. MacMillan, 2012

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Course Originator: David Locke