Course Number: COSC xxx

Course Title: Quantum Mechanics for Computer Scientists

Number of Credit Hours: 3

**Catalog Description**:

COSC xxx Quantum Mechanics for Computer Scientists – Three hours of lecture, 3 credits.

This course introduces computer science majors to quantum mechanics. Concepts of quantum wave functions, Heisenberg uncertainty, probabilities, superposition states and entanglement, and the qubit will be covered. The use of quantum states and quantum operators as fundamental tools, including utilization of matrices, will be part of this course. The quantum nature of atoms and photons will be considered, including lasers and their interaction with matter.

Prerequisite: Physics Course, Math Course ??

**Course Objectives**

Upon completion of this course, students will be able to do the following:

• Describe fundamental quantum mechanical principles.

• Analyze mathematical and experimental foundations of quantum mechanics.

• Demonstrate skills by solving quantum mechanics equations and conducting quantum-relevant experiments

**Course Content (Statement of Subject Matter):**

Unit 0: Review of classical physics

Unit 1: Foundations of Quantum Mechanics

Unit 2: Quantum Schrodinger equation, state representations, and qubits

Unit 3: Laser interactions with matter

Unit 4: Quantum operators and matrix approaches

Unit 5: Quantum superposition

Unit 6: Quantum entanglement

Unit 7: Quantum non-classical correlations

Unit 8: Quantum Bell states

**Course Schedule**

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| --- | --- | --- | --- |
| **Week** | **Unit** | **Unit Name** | **Computer Lab/Project** |
|  |  |  |  |
| 1 | 0 | Review of classical physics |  |
| 2-3 | 1 | Foundations of quantum mechanics | Wave nature of photons |
| 4-5 | 2 | Quantum Schrodinger equation, state representations, and qubits | Two-photon interference |
| 6 | 3 | Laser interactions with matter | Quantum eraser |
| 7-8 | 4 | Quantum operators and matrix approaches |  |
| 9-10 | 5 | Quantum superposition | Nonclassical Correlations Part 1 |
| 11-12 | 6 | Quantum entanglement | Nonclassical Correlations Part 2 |
| 13-14 | 7 | Quantum non-classical correlations | Violating Bell’s Inequality Part 1 |
| 15 | 8 | Quantum Bell states | Violating Bell’s Inequality Part 2 |
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**Bibliography:**

* Quantum Mechanics for Beginners: With Applications to Quantum Communication and Quantum Computing. Suhail Zubairy. Oxford University Press. ISBN-13: 978-0198854234, 2020.
* Quantum Physics for Beginners: The Complete Overview How to Easily Understand the All Principles of Quantum Mechanics in Everyday Life. James Philips. Springer. ISBN-13: ‎ 979-8883737823, 2024.