Course Content	
Course Title (English)	Quantum Information and Computation
Course Title (Chinese)	量子資訊與計算
Credit	3
Instructor	Prof. Hao-Chung Cheng 鄭皓中 教授
Description	This course presents the subject of quantum information processing, which lies at the intersection of mathematics, physics, computer science, and engineering. We explore the mathematical foundation of how to manipulate, store, transmit, and compute quantum information, that are fundamental to a broad range of studies including quantum computing, quantum communications, and quantum cryptography. Most of these studies have demonstrated striking and transformative features, which hence facilitate the rapid developments of current quantum information technologies. The course is intended for graduate students (undergraduate students are also welcome) who have previously taken courses of linear algebra and basic probability theory. No previous background in quantum mechanics is required.
Outline	1. Foundations of Quantum Theory I: Postulates and Quantum States. 2. Foundations of Quantum Theory II: Measurements and Operations. 3. Basic Quantum Protocols. 4. Quantum Computation I: Quantum Circuit Model and Algorithms.

	5. Quantum Computation II: Algorithms with Super-polynomial Speed-up 6. Quantum Computation II: Algorithms based on Amplitude Amplification 7. State Discrimination and Semidefinite Programming. 8. Quantum Shannon Theory I: Entropy and Quantum Hypothesis Testing. 9. Quantum Shannon Theory II: Quantum Compression. 10. Quantum Shannon Theory III: Quantum Communication. 11. Quantum Cryptography: Quantum Key Distribution. 12. Advanced Topics: Quantum Error Correction (as time permits).
Goal	1. Introduce fundamental concepts and mathematical framework of quantum information (the so-called quantum bits) - how to model it, process it, and measure it. 2. Present core quantum computing topics including quantum circuit models and basic quantum algorithms, and how to harness quantum computing power to speed-up classical computational tasks. 3. Learn various quantum information-processing protocols including compressing quantum information and communicating classical/quantum information through a quantum channel. 4. Develop necessary abilities for students to independently study advanced topics in quantum information sciences and to innovate applications in quantum information technology. 5. Perform a term project on studying advanced topics of the latest research, experiment development, technologies of quantum information processing.
English Teaching	☐ YES ■ NO
Teaching Material	■ English ☐ Chinese