Quantum (QTM)

QTM 161. Quantum Computing Basics. (3)
This introductory course covers the basics of quantum computing and explores their applications across various industries such as finance, life sciences, pharmaceuticals, global energy, cybersecurity, etc. Students will gain a basic understanding of quantum computing concepts and the advantages of quantum science and technology in solving complex real-world problems. The course also explores future trends in the field and includes case studies to demonstrate how quantum computing can transform various industries.
Prerequisites: CSE 174, MTH 151.

QTM 261. Quantum Information Processing. (3)
This course covers the foundations of quantum information processing. Topics include qubits, quantum states and the measurement, unitary operations, Hadamard transform, quantum circuits, quantum protocols, the no-cloning theorem, quantum error correction, quantum communication, and quantum information theory (such as the von Neumann entropy, entanglement distribution, quantum data compression). These principles and techniques enable quantum computers to tackle challenging problems in fields like cryptography, optimization, and simulation at speeds, scales, and properties unattainable by classical computers.
Prerequisites: QTM 161, CSE 274, (STA 261 or STA 301), MTH 246, and (MTH 231 or MTH 331).

QTM 361. Quantum Algorithms. (3)
This course utilizes the computational advantages offered by quantum information to design, analyze, and implement quantum algorithms, as well as to examine their significance in quantum computing. The course covers quantum algorithms such as quantum query algorithms, Grover's unstructured search algorithm, phase estimation, Shor's algorithm for integer factorization, and quantum algorithms for some number-theoretic problems such as the discrete logarithm (DL) and the hidden subgroup problem (HSP).
Prerequisites: QTM 261, CSE 374.

QTM 461/QTM 561. Quantum Security Standards: FIPS 203 and FIPS 204. (3)
This course covers two post-quantum cryptography standards, FIPS 203 and FIPS 204, which were announced by NIST in August 2024. FIPS 203 specifies the Module-Lattice-based Key Encapsulation Mechanism (ML-KEM), and FIPS 204 specifies the Module-Lattice-based Digital Signature Algorithm (ML-DSA).
Prerequisites: QTM 161, CYB 236, CSE 274, MTH 246.

QTM 462/QTM 562. Advanced Quantum Computing Applications. (3)
This course provides an in-depth study of several real-world applications of quantum computing. It highlights the impact of quantum algorithms for solving challenging problems and discusses case studies for innovative applications. The course also covers current challenges and future trends in quantum science and technology.
Prerequisites: QTM 361 and CSE 432/CSE 532.