CS 1190: Fundamentals of Quantum Information Science
Fall 2026

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Logistics

- **Course Website:** qis.rahmanmsaidur.com
- **Class Schedule:** Mondays, 3:00 PM–4:20 PM Mountain Time (MT).
- **Location:** Texas Western Hall 317.
- **Mode of Instruction:** In person.
- **Course Period:** August 24, 2026 – December 3, 2026.
- **Office Hours:** Tuesdays, 2:00 PM–3:00 PM Mountain Time (MT).
- **Microsoft Teams:** Microsoft Teams will be used for course announcements, discussions, questions, and communication.
- **Microsoft OneNote:** OneNote will be used for course notes, supplementary materials, and selected in-class activities.
- **Quantum Computing Platforms:** IBM Quantum, IBM Quantum Composer, and Qiskit will be used for selected demonstrations and hands-on activities.
- **Note Taking:** Students are strongly encouraged to bring a pen or pencil and paper to every class. Many quantum concepts will be developed using diagrams, circuits, calculations, and step-by-step examples.
- **Communication:** Students should use Microsoft Teams for general course-related questions so that the answers can benefit the entire class. Questions involving private or individual matters should be sent directly by email.
- **Academic Accommodations:** Students who require academic accommodations should contact the Center for Accommodations and Support Services (CASS) as early as possible. Approved accommodations will be provided according to the student's CASS accommodation letter.
- **Academic Integrity:** Academic integrity is required in all course activities and assessments. See Section for details.

Course Overview

This course provides an introduction to quantum information science from a computer science perspective. Students will learn how quantum information differs from classical information and develop an intuitive understanding of qubits, superposition, measurement, quantum gates, interference, and entanglement. The course also introduces quantum circuits, basic quantum algorithms, quantum communication, and the impact of quantum computing on cybersecurity. Students will use simple circuit demonstrations and hands-on activities to connect fundamental concepts with current quantum computing platforms. No prior background in quantum physics is required.

Why Quantum Information Science?

Quantum information science introduces a fundamentally different way to represent, process, and communicate information. Its principles are increasingly important in computing, cybersecurity, communication, and emerging quantum technologies. This course provides the foundation needed to understand these developments and pursue further study in quantum computing, quantum communication, or quantum security.

Course Objectives

- Introduce the basic principles of quantum information and computation.
- Explain how qubits and quantum operations differ from classical bits and operations.
- Develop an intuitive understanding of measurement, interference, and entanglement.
- Introduce quantum gates, circuits, and basic quantum algorithms.
- Connect quantum computing to cybersecurity, cryptography, and communication.
- Provide hands-on experience with simple quantum circuits and quantum computing platforms.
- Prepare students for further coursework or research in quantum computing and quantum security.

Course Learning Outcomes

- Explain the difference between classical bits and qubits.
- Describe superposition, measurement, and quantum states at an introductory level.
- Interpret and construct simple quantum circuits using common quantum gates.
- Explain how interference is used in quantum computation.
- Describe entanglement and distinguish it from classical correlation.
- Explain the basic ideas behind no-cloning and quantum teleportation.
- Describe the purpose and significance of selected quantum algorithms.
- Explain how quantum computing affects modern cryptography and cybersecurity.
- Build and simulate simple quantum circuits using a quantum computing platform.
- Identify major limitations of current quantum computers, including noise and errors.

Prerequisites

- Completion of an introductory programming sequence (CS I/CS II or equivalent) is recommended.
- Basic familiarity with discrete mathematics is helpful.
- No prior knowledge of quantum mechanics or quantum physics is required.
- Linear algebra is helpful but not required. The necessary concepts will be introduced as needed.

Grade Breakdown

The final grade will be based on the following components:

- **Attendance (20%)**
- **Six Quizzes (40%):**
  - Quiz 1: Classical Information, Qubits, and Superposition
  - Quiz 2: Measurement, Probability, Quantum Gates, and Circuits
  - Quiz 3: Quantum Interference, Multiple Qubits, and Controlled Operations
  - Quiz 4: Entanglement, Bell States, and Quantum Correlations
  - Quiz 5: No-Cloning and Quantum Teleportation
  - Quiz 6: Quantum Algorithms and Cybersecurity
- **Hands-On Activities (20%)**
- **Final Concept Presentation (10%)**
- **Professionalism (10%)**

Grading Policy. Final course grades will be assigned according to the following scale:

- A: 90–100%
- B: 80–89%
- C: 70–79%
- D: 60–69%
- F: Below 60%

Attendance. Attendance accounts for 20% of the final course grade. Because the course meets only once per week, each class covers a substantial amount of material. Attendance will be recorded at every class meeting. Students are responsible for material, announcements, quizzes, and activities completed during missed classes. Excused absences will be handled according to University policy.

Quizzes. The course includes 6 quizzes designed to evaluate important concepts independently as the course progresses.

- Quizzes will primarily evaluate conceptual understanding rather than memorization.
- Questions may include short explanations, circuit interpretation, simple calculations, and conceptual problems.
- Each quiz will normally require approximately 15–20 minutes.
- The six quizzes together account for 40% of the final grade.

Hands-On Activities. The course includes three hands-on activities using IBM Quantum tools to connect fundamental concepts with simple quantum experiments.

- **Activity 1: Qubits, Gates, and Measurement.**
  Students will use IBM Quantum Composer or Qiskit to construct simple one-qubit circuits, apply basic quantum gates, perform measurements, and compare observed measurement outcomes with expected probabilities.
- **Activity 2: Quantum Interference and Entanglement.**
  Students will construct circuits that demonstrate quantum interference and create a Bell state using Hadamard and controlled-NOT gates. Students will examine measurement results and explain how interference and entanglement affect the observed outcomes.
- **Activity 3: Simulation vs. Real Quantum Hardware.**
  Students will run a quantum circuit using both an ideal simulator and an IBM quantum processor. They will compare the measurement results and examine how noise and hardware errors cause real quantum execution to differ from ideal behavior.

Hands-On Activity Evaluation. Hands-on activities will be evaluated based on:

- Correct construction and execution of the required circuit or experiment.
- Correct interpretation of measurement results.
- Clear explanation of the quantum concept demonstrated by the activity.
- Completion of the required questions or short analysis.

Final Concept Presentation. Each student will select one quantum information science concept covered in the course and give a short individual presentation explaining the concept to a computer science audience.

The presentation should be approximately 5–7 minutes and should address the following:

- **What is the concept?** Clearly define the selected quantum information concept.
- **How does it work?** Explain the main idea using appropriate diagrams, quantum states, gates, circuits, or other examples.
- **Example or Demonstration.** Provide a simple example, circuit, visualization, or demonstration illustrating the concept.
- **Why does it matter?** Explain its importance to quantum computing, communication, cybersecurity, or another computing application.
- **Key Limitation or Misconception.** Identify at least one important limitation, assumption, or common misunderstanding associated with the concept.

Presentation Evaluation. The presentation will be evaluated using the following criteria:

- **Technical Correctness (40%):** The concept and underlying quantum principles are explained correctly.
- **Conceptual Understanding (25%):** The student demonstrates understanding rather than simply repeating definitions.
- **Example or Demonstration (15%):** The example, circuit, or visualization correctly illustrates the concept.

- **Clarity and Organization (10%):** The presentation is clear, focused, and understandable to a computer science audience.
- **Questions and Professionalism (10%):** The student responds appropriately to questions and presents the material professionally.

Possible Presentation Topics. Examples include, but are not limited to:

- Superposition
- Quantum Measurement
- Quantum Interference
- Entanglement
- Bell States
- No-Cloning
- Quantum Teleportation
- Grover's Algorithm
- Shor's Algorithm
- Quantum Error Correction
- Quantum Key Distribution
- Post-Quantum Cryptography

Professionalism. Professionalism accounts for 10% of the final course grade. Students are expected to contribute to a respectful and productive learning environment.

Professionalism includes:

- Coming to class prepared.
- Participating constructively in class discussions and activities.
- Following instructions during quizzes and hands-on activities.
- Communicating respectfully with classmates and the instructor.
- Using Microsoft Teams, OneNote, and other course platforms appropriately.
- Completing course activities responsibly and demonstrating appropriate academic and professional conduct.

Submission Policy

- **Deadlines:** All assignments and hands-on activities must be submitted by the specified due date and time.
- **Late Submissions:**
  - Up to 24 hours late: 10% deduction.
  - 24–48 hours late: 50% deduction.
  - More than 48 hours late: no credit.
- **Extensions:** Extensions may be granted for serious or extraordinary circumstances when requested before the deadline. Documentation may be required.
- **Technical Issues:** Students should plan ahead when using online platforms and avoid waiting until the deadline to submit work.

Course Syllabus

- Microsoft Teams will be used for announcements and course communication.
- OneNote will be used for course notes and supplementary materials.
- IBM Quantum, IBM Quantum Composer, and Qiskit will be used for selected demonstrations and hands-on activities.
- Students are strongly encouraged to bring pen/pencil and paper to every class.
- The schedule is tentative and may be adjusted based on the progress of the class.

forms responsibly.

Submission Policy.

- **Deadlines:** Course work must be submitted by the specified deadline.
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- **Extensions:** Extensions may be granted for serious circumstances when requested before the deadline.

Tentative Course Syllabus

The schedule may be adjusted based on the progress of the class.

Week	Date	Class Content	Assessment / Activity
Week 1	08/24	**Why Quantum Information Science?** • Classical vs. quantum information • Why quantum computing matters	Lecture
Week 2	08/31	**From Bits to Qubits** • Qubits and quantum states • Superposition	Lecture
Week 3	09/07	**NO CLASS – Labor Day**	
Week 4	09/14	**Measuring a Qubit** • Measurement and probability • Basic math for qubits	Quiz 1
Week 5	09/21	**Quantum Gates and Circuits** • Basic quantum gates • Building simple quantum circuits	Hands-On Activity 1
Week 6	09/28	**Quantum Interference** • How quantum possibilities combine • Interference in simple circuits	Quiz 2
Week 7	10/05	**Multiple Qubits** • Two-qubit systems • Controlled operations and the CNOT gate	Lecture
Week 8	10/12	**Quantum Entanglement** • Bell states • Creating entangled qubits	Quiz 3
Week 9	10/19	**Understanding Entanglement** • Measuring entangled qubits • Quantum correlations	Hands-On Activity 2

Week	Date	Class Content	Assessment / Activity
Week 10	10/26	**No-Cloning** • Why unknown quantum information cannot be copied	Quiz 4
Week 11	11/02	**Quantum Teleportation** • Using entanglement to transfer quantum information	Lecture
Week 12	11/09	**Quantum Algorithms** • How quantum algorithms differ from classical algorithms • Quantum search and examples of quantum speedup	Quiz 5
Week 13	11/16	**Quantum Computing and Cybersecurity** • Shor's and Grover's algorithms • Quantum threats and post-quantum security	Lecture
Week 14	11/23	**Real Quantum Computers** • Running circuits on quantum hardware • Noise, errors, current limitations, and future directions	Quiz 6 Hands-On Activity 3
Week 15	11/30	**Final Concept Presentations**	

POLICIES

EXCUSED ABSENCES AND COURSE DROP POLICY. According to the UTEP Catalog, an instructor may drop a student for excessive absences or lack of effort. A "W" will be assigned before the course drop deadline and an "F" after the deadline. See the UTEP Catalog for University policies on excused absences and course drops.

ACCOMMODATIONS POLICY. UTEP provides reasonable accommodations for students with documented disabilities and for eligible students who are pregnant. Students requesting accommodations should contact the Center for Accommodations and Support Services (CASS) as early as possible at 915-747-5148, `cass@utep.edu`, or through the CASS portal.

INCOMPLETE GRADE POLICY. Incomplete grades may be granted only in exceptional circumstances after at least half of the course requirements have been completed. Students should contact the instructor as soon as possible. If approved, the remaining work and deadlines will be documented.

ACADEMIC INTEGRITY. Academic dishonesty, including cheating, plagiarism, and collusion, is prohibited. Suspected violations must be reported to the Office of Community Standards. See HOOP: Student Conduct and Discipline for University policy.

Students may discuss course concepts and consult appropriate learning resources, but all submitted work must reflect their own understanding.

- **OK:** Discuss concepts with classmates and consult textbooks, papers, documentation, and other permitted resources.

- **OK:** Use existing examples or code when permitted, provided the original source is clearly cited.
- **NOT OK:** Copy answers, quiz responses, activity results, code, or presentation materials from another student or source.
- **NOT OK:** Have another person complete course work or present someone else's work as your own.
- External resources used in submitted work must be properly acknowledged.

GUIDANCE ON ARTIFICIAL INTELLIGENCE. Generative AI tools may be used for permitted learning and exploration, but they can produce incorrect or misleading information. Students remain responsible for the accuracy of their work. AI-generated material may not be submitted as the student's own work, and any permitted use of AI must be clearly disclosed and cited.

COURSE MATERIALS. Course materials are provided for educational use. Students may not redistribute quizzes, solutions, or other assessment materials in ways that compromise future offerings of the course.

COURSE POLICY MODIFICATIONS. The instructor may modify the syllabus, schedule, activities, or grading procedures when necessary. Significant changes will be communicated through official course channels.