Course Title: **Quantum Error Correction**

Credit Hrs: **3**

Prerequisites: Quantum basic coding theory

Course Description:

The course covers the theory and techniques to protect quantum information from noise, quantum error-correcting codes, stabilizer formalism, CSS codes, and fault-tolerant quantum computation.

Course Objectives:

1. Understand quantum error models and correction principles
2. Master stabilizer codes and surface codes
3. Design fault-tolerant quantum computing protocols

Course Learning Outcomes: Students will be able to:

1. Analyze quantum error channels and noise models
2. Implement quantum error correction codes
3. Design fault-tolerant quantum circuits
4. Evaluate error correction performance metrics

Course Contents:

Week	Contents
1-2	Quantum errors and decoherence models
3-4	Three-qubit code and CSS codes
5-6	Stabilizer formalism and codes
7-8	Surface codes and topological protection
9-10	Fault-tolerant quantum computing
11-12	Quantum error mitigation techniques
13-14	Threshold theorems and scaling
15-16	Practical error correction implementations

Textbooks/ References:

1. Lidar, D.A. & Brun, T.A. "Quantum Error Correction" (2013)
2. Terhal, B.M. "Quantum Error Correction for Quantum Memories" (2015)

Assessments:

1. Assignments: 10%
2. Quizzes: 10%
3. Midterm Exam: 30%
4. Final Exam: 50%