Course Title: **Open Quantum Systems**

Credit Hrs: **3**

Prerequisites: Quantum Basics & advanced mathematics

Course Description:

The course provides students with the formalisms and methods to model these systems, including density matrices, quantum operations, and master equations. It also provide understanding to system-environment interactions, deriving equations for non-unitary dynamics, and applying theory to real-world quantum technologies.

Course Objectives:

1. Understand quantum systems interacting with environments
2. Master decoherence and dissipation theory
3. Apply open system methods to practical quantum devices

Course Learning Outcomes: Students will be able to:

1. Model quantum systems coupled to environments
2. Analyze decoherence and relaxation processes
3. Apply master equation approaches
4. Design decoherence mitigation strategies

Course Contents:

Week	Contents
1-2	Closed vs open quantum systems
3-4	System-environment coupling models
5-6	Born-Markov approximation and master equations
7-8	Lindblad dynamics and quantum jumps
9-10	Decoherence in quantum computing systems
11-12	Quantum process tomography
13-14	Dynamical decoupling and error suppression
15-16	Applications to quantum devices

Textbooks/ References:

1. Breuer, H.P. & Petruccione, F. "The Theory of Open Quantum Systems" (2007)
2. Rivas, A. & Huelga, S.F. "Open Quantum Systems" (2012)

Assessments:

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

Final Exam: 50%