# INTRODUCTION TO QUANTUM INFORMATION SCIENCE, ECE 548

Quantum phenomena provide computing and information handling paradigms that are distinctly different and arguably much more powerful than their classical counterparts. In the past quoter of the century, much progress has been made on the theoretical side, and experiments have been carried out in which quantum computational operations were executed on a very small number of quantum bits. The NSF has declared this general area to be one of the 10 big ideas for future investments.

This new course will provide an introduction to the theory of quantum computing and information. The topics that will be covered are include 1) the fundamental elements of quantum information processing (qubits, unitary transformations, density matrices, measurements); 2) entanglement, protocols for teleportation, the Bell inequality, 3) basic quantum algorithms such as Shors factoring and Grovers search, and 4) basic quantum data compression and error correction. The course material will be accessible to undergraduate and graduate students with a variety of backgrounds, e.g., electrical engineers, physicists, mathematicians, and computer scientists.

**Learning Objective:**
The students will learn the fundamentals of quantum information science, as well as a selected number of more advanced topics of their individual interests.

**Instructor:** Emina Soljanin emina.soljanin@rutgers.edu, CoRE 511, 848-445-5256.

**Office hours:** TBD & by appointment,

**Class time and place:** TBD

**Prerequisites:** Calculus, linear algebra, and probability at an undergraduate level as well as familiarity with complex numbers are required. Prior exposure to quantum mechanics and information/coding theory is helpful but not essential.

**Grading:** homework homework 20%, 2 midterm exams 20% each, final exam 40%.
(Exams will be in class, approximately late September and late October)

**Text:** N. D. Mermin, *Quantum Computer Science: An Introduction,* Cambridge Univ. Press (2007)
(see attached table of contents)

**Course notes:** given per week in separate documents on the class Sakai page.

**Final remark:** The topics outlined above are very common for a quantum information science course at this level. Such courses have been thought at many universities for many years, e.g. for almost two decades at Cornell based on the proposed textbook.

# Quantum Computer Science
# An Introduction



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