CENG 487 - Introduction to Quantum Computing

- **Course Description:** Fundamental concepts in quantum computing; quantum mechanics for computer scientists; quantum circuits and quantum instruction set; quantum programming languages; quantum algorithms; error correction and fault tolerance.

- **Instructor:**

  Murat Manguoğlu
  Office: A407, Phone: 210 5551
  Email:*manguoglu[at]ceng.metu.edu.tr*
  Office hours: Tuesday 9:30-10:30

- **Teaching assistant:**

  TBD

- **Schedule:**

  Monday 9:40-10:30 BMB4
  Wednesday 9:40-11:30 BMB4

- **Prerequisites:** Linear algebra and algorithms are required. A background in physics is **not** required.

- **Textbooks:**

    - Quantum Computing and Quantum Information, 10th Anniversary Edition Nielsen and Chuang, 2016

    - Quantum Computing for Computer Scientists, Yanofsaky and Mannucci, 2008

- **Grading:** (tentative) The grading policy is listed below. Exam dates will be announced later.

Midterm	35%
Final	45%
Homeworks ($\times 4$)	20%

- **Homework:** There will be 4 programming homework assignments. Delayed submissions are accepted with a penalty of $-5 \times d^2$ where d is the number of days in which the solution is submitted late.

- **Examinations** The midterm and final are closed book and notes. Only one page (no larger than A4) and **hand-written** cheat sheet is allowed. The time and location will be announced later.

- **Attendance and Participation**

  Attendance and participation in class and office hours are encouraged. I will randomly check attendance, and I may use it in your favor when assigning letter grades.

- **Communication:**

  Announcements about the course will be made in class and on odtuclass. Please attend the class and follow odtuclass announcements.

- **Academic Integrity:**

  All homework, midterm, and final are expected to be individual work. Discussion of ideas or concepts are allowed and encouraged for the homeworks. However, when writing your code or solution, you should not look at other people's work. If you use a source (online or offline) you are expected to cite it. Violation of these general principles will be handled according to university regulations and may result in disciplinary action.

- **Outline:** (tentative)

  - Introduction, history and motivation
  - Basic operations with 1 qubit
  - Multi qubit systems, bell states , and teleportation and superdense coding
  - Quantum parallelism, Deutsch's, Deutsch-Jozsa and Simon's algorithms
  - Common and alternative physical implementations of quantum computers, quantum noise and basic quantum error correction
  - Quantum Fourier transform
  - Quantum phase estimation and eigenvalue solver
  - Quantum order finding
  - Grover's search algorithm
  - Quantum Complexity
  - Quantum counting and other applications [**if time permits**].