

ESE 512 Syllabus  
Spring 2021

Prof. Thomas Robertazzi, Instructor

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Learning Objective: To give students a broad introduction to quantum computing and information system including the underlying math and quantum circuits.

This is a course that is completely online with synchronous lectures on late Monday afternoons. Videos are available for all of the lectures if you can't make a class.

Texts:

- (A) **Required:** Quantum Computing for Everyone by Chris Bernhardt, MIT Press, 2019. A very accessible book for the subject. Pretty inexpensive too.
- (B) **Optional:** Chapter 1 of Quantum Computation and Quantum Information by Michael Nielsen and Isaac Chuang, Cambridge University Press, 2000. At a higher level than the Bernhardt book but chapter 1 has similar coverage.

Week 1 (Week of Jan. Feb 1<sup>st</sup>): Introduction (see Chuang videos Overview I, II and III).

Week 2 (Feb. 8): Chapter 2: Linear Algebra (use Bernhardt book and videos from this point)

Week 3 (Feb. 15): Chapter 2: Linear Algebra (continued). **Essay 1 due Feb. 14 (on some aspect of Quantum History).**

Week 4 (Feb. 22): Chapter 4: Entanglement.

Week 5 (March 1st): Chapter 4: Entanglement (continued). **Essay 2 due Feb. 28 (on some aspect of entanglement).**

Week 6 (March 8): Classical Gates and Circuits

Week 7 (March 15): Quantum Gates and Circuits.

Week 8 (March 22): Quantum Gates and Circuits (continued)

Week 9 (March 29): **Self-midterm due March 28<sup>th</sup>.**

Week 10 (April 5): Quantum Algorithms. **Essay 3 due April 4<sup>th</sup> (on some aspect of quantum gates and circuits).**

Week 11 (April 12): Quantum Algorithms (continued). **Essay 4 due April 11<sup>th</sup> (on some aspect of quantum algorithms).**

Week 12 (April 19): Quantum Algorithms (continued).

Week 13: (April 26): IBM Architecture (and SWAP gates) and Quantum Computer Hardware. **Self-final due April 25<sup>th</sup> (see below).**

Week 14 (May 3<sup>rd</sup>): Implementation (Ion Traps).

Grading:

Midterm: 30%, Essays (four assignments at 10% each): 40%, Self-Final: 30%

Total is 100 points.

Essays: For some topics specified by the professor you will write 500 words on some aspect of the chapter coverage that you find interesting or on a chapter related paper. Additional sources can be used but are not necessary. Please cite source(s) (any citation style is fine). A good place to find articles is the library website under Databases and then maybe under ieeexplore or Science Direct. Another good place to look for papers is Google Scholar. See syllabus for due dates.

Self-Midterm Exam:

Students create four problems and answers involving quantum calculations covered in the first half of the course. See last year's midterm for representative questions. Grading is based on choice of questions and correctness of answers. See syllabus for due date.

Self-Final Exam:

Students create their own exam, consisting of five qualitative questions and answers. Grading is based on choice of questions and reasonableness of answers. Questions should make one think a bit. See syllabus for due date.

*Note: If you have a physical, psychological, medical or learning disability that may impact on your ability to carry out assigned course work, I would urge you to contact the staff in the Student Accessibility Support Center (SASC) at 631-632-6748. SASC will review your concerns and determine with you what accommodations are necessary and appropriate. All information and documentation of disability are confidential.*