

ECE 5/7383

Introduction to Quantum Informatics

Instructor: Mitch Thornton



GOAL: Introduction to Information Representation, Manipulation, and Measurement using Quantum Mechanics

<http://lyle.smu.edu/~mitch/class/5383/index.html>

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Class Grades

- ***In-class Exercise and Homework*** (20%)
 - Can be Presentation, Quiz, Guided Exercise, Homework Assignment
- ***Examination 1*** (20%) – Closed Notes
- ***Examination 2*** (20%) – Closed Notes
- ***(Final) Examination 3*** (20%) – Project Paper
- ***Project*** (20%) – 15 to 20 Minute Project Video/Presentation Slides

REFER TO ONLINE GRADING POLICY!!!!

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Desired Student Background

- **Math** – linear algebra, discrete mathematics, probability and statistics
- **Physics** – basic Physics courses (calculus-based) required for undergraduate in the sciences/engineering, an introduction to quantum mechanical principles is desirable but not necessary
- **ECE/CS** – exposure to computer organization/programming/assembly, digital logic fundamentals, basic communication/network concepts are DESIRABLE

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Books and Reading Material

Class will use Online Materials and Text

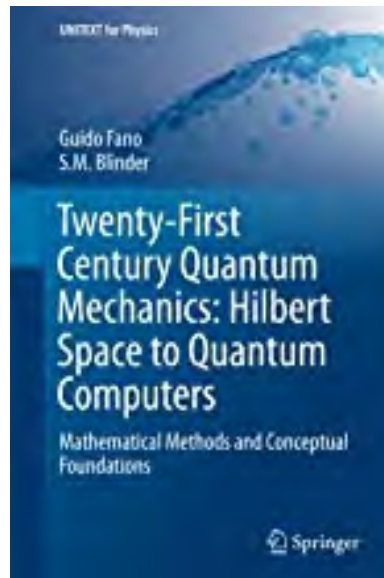
- ***Twenty-First Century Quantum Mechanics: Hilbert Space to Quantum Computers***
 - ***G. Fano and S. Blinder***

References

- ***A Student's Guide to Waves***
 - ***D. Fleisch and L. Kinnaman***
- ***A Student's Guide to Lagrangians and Hamiltonians***
 - ***P. Hamill***
- ***A Student's Guide to Schrödinger's Equation***
 - ***D. Fleisch***

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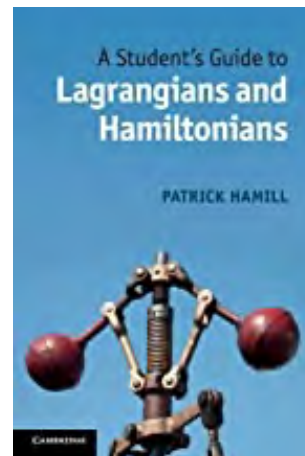
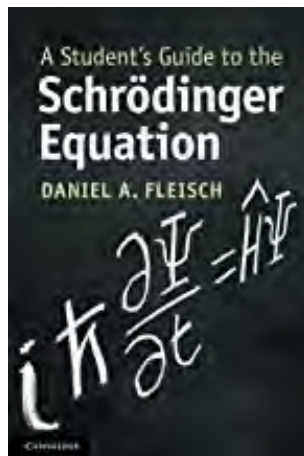
Required Textbook



<https://www.springer.com/us/book/9783319587318>

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Listed Reference Textbooks



<https://www.cambridge.org/gb/academic/collections/physics-student-guide>

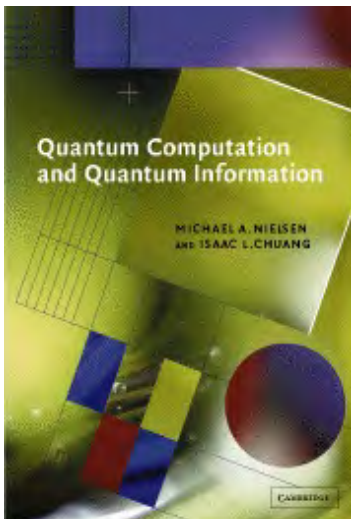
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Other Sources

- **See Class Schedule Page to Guide Reading**
- **Links to some Online Sources:**
- **From Classical to Quantum Theory**
 - **Mark M. Wilde, [Creative Commons-Non-commercial Sharealike 3.0 Unported License](#)**
- **Quantum Physics arXiv**
- **Academia.edu Website**

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All-inclusive Reference Textbook



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Online Notes

- Online Notes contain the most important portions of the course material
- Accessible at:
<https://s2.smu.edu/~mitch/class/5383/schedule.html>
- Notes (may be) Password Protected
- Authentication Credentials (case sensitive):

Username: **5395-QI**

Password: **MustangQ**

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Material other than Notes

- Selected Material from:
 - References
 - Historical Readings
 - Archived Papers
 - Other Web Resources
- Will place all notes online, BUT,
 - **YOU SHOULD TAKE NOTES ALSO**
- URLs/Links Available in Class Syllabus:

<https://s2.smu.edu/~mitch/class/5383/index.html>

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General Topic Outline

- Physics Fundamentals and Waves
- Review of Linear Algebra Topics
- Quantum Harmonic Oscillator and Schrödinger's Equation
- Information Representation & Communication
 - Classical and Quantum
- Quantum Communication Topics
- Quantum States and Measurement
- The Concept of the Qubit

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General Topic Outline (cont)

- Quantum Superposition, Entanglement, Projective Measurement
- Physical Computation & Reversible Logic
- Qubit State Transformation: Quantum Logic Gates
- Quantum Algorithms as Circuits
- Introduction to Technology

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Quantum Characteristics Exploited for QIS

- Quantum Superposition
- Entanglement
- Teleportation
- Pure and mixed states
- Observables and Measurement
- No cloning theorem