20-EECE-5122C/6022C	QUANTUM SYSTEMS
Required/Elective	Elective for EE and CompE majors; elective for EE and CompE graduate students
Catalog Data	20-EECE-5122C/6022C. Quantum Systems. Credits 3. Introduction to principles of quantum mechanics and practical applications of the field.
Prerequisites / Corequisites	Prereq.: EECE 2076 - Semiconductor Physics / EECE 2077 Semiconductor Devices / Modern Physics class (intro to quantum mechanics) or permission of instructor. Corequisites: suggested: 15PHYS6010 Introduction to Quantum Mechanics
Prerequisites by Topic	Basics of semiconductor physics and devices, introduction to modern physics, early years of quantum mechanics
Textbook	Instructor's notes
References	1. Gasiorowicz, S. (1996), Quantum Physics, Wiley, New York. 2. Fromhold, A. T. (1981) Quantum Mechanics for Applied Physics and Engineering}, Academic Press, New York. 3. Datta, S. (1989) Quantum Phenomena, Volume III, Modular Series, Addison-Wesley, Reading, MA. 4. Bohm, A., (1993) Quantum Mechanics: Foundations and Applications, Springer-Verlag, New York. 5. Kroemer, H. (1994) Quantum Mechanics for Engineering, Materials Science, and Applied Physics, Prentice-Hall, Englewood Cliffs, New Jersey. 6. Datta, S. (1995) Electronic Transport in Mesoscopic Systems, Cambridge University Press, Cambridge. 7. Singh, J. (1997) Quantum Mechanics: Fundamentals and Applications to Technology, Wiley, New York. 8. Basdevant, J. L. (2000) The Quantum Mechanics Solver: How to Apply Quantum Theory to Modern Physics, Springer, Berlin. 9. Townsend, J. S. (2000) A Modern Approach to Quantum Mechanics, University Science Books, CA. 10. Ferry, D. K. (2001) Quantum Mechanics: An Introduction for Device Physicists and Electrical Engineers, Institute of Physics Publishing, London. 11. Rae, A. I. M. (2002) Quantum Mechanics, Taylor and Francis, New York. 12. Gottfried, K. and Yan, T.-M. (2004) Quantum Mechanics, Springer, New York. 13. Basdevant, J. L. and Dalibard, J. (2005) Quantum Mechanics, Springer, New York. 14. Levi, A. F. J. (2006) Applied Quantum Mechanics, Cambridge University Press, New York. 15. Le Bellac, M. (2006) Quantum Physics, Cambridge University Press, New York. 16. Additional references will be provided through the class blackboard site, as needed
Goals	Students will learn the principles of quantum mechanics with a historical perspective of the field. The student will learn how to solve simple bound states and scattering problems and how to apply them to study the electrical and optical properties of nanoscale devices.
Topics	1. General Properties of the Schrödinger Equation 2. Operators 3. Boundstates 4. Heisenberg Principle

	5. Current and Energy Flux Densities 6. Density of States 7. Transfer Matrix 8. Scattering Matrix 9. Perturbation Theory 10. Variational Approach 11. Electron in a Magnetic Field 12. Electron in an Electromagnetic Field and Optical Properties of Nanostructures 13. Time Dependent Schrödinger Equation 14. other selected topics		
Additional Work for Grad Students	Graduate students will be required to do a literature search on a specific current research topic in nanotechnology and apply the material taught in this class to analyze a specific paper in details.		
Class/Laboratory Schedule	class meets 3 times a week for 55 minutes; each team meets an additional 20 minutes every week with instructor to report on their project		
ABET Outcomes	a, b, e, g1, g2, j		
Course Learning Objectives	Students will: 1. Learn how to apply the principles of quantum mechanics to practical problems (a,b) 2. Learn how to solve both analytically and numerically practical quantum mechanical problems (a) 3. Learn how to use Latex to type their reports including appropriate formatting of equations (a,e) 4. Students will learn how to do literature search on specific topic (a) 5. Students will learn how to use Matlab to solve practical problems in quantum mechanics (a,e) 6. Do a presentation and write a report on their project (g1,g2)		
Computer Usage	Students will use sharelatex to write their reports and Matlab to solve practical problems in quantum mechanics		
Contribution to Professional Component	Engineering science: 2 credit or 66%; Engineering design: 1 credits or 33%		
Prepared by	Marc Cahay, Ph.D.	**Date**	August 07, 2016
Approved by Undergraduate Council		**Date**	