Course Syllabus
Fall 2016

EEMF 6319 Quantum Physical Electronics

Professor Contact Information

William R. Frensley (972) 883-2412
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Course Pre-requisites, Co-requisites, and/or Other Restrictions
(including required prior knowledge or skills)

Requisite Knowledge:

Calculus-based undergraduate Physics: Mechanics and Electricity & Magnetism
Engineering Electromagnetic theory
Linear Algebra (vector spaces, matrices, eigenvalues).
Differential Equations and Partial Differential Equations.

Course Description

Quantum-mechanical foundation for study of nanometer-scale electronic devices. Principles of quantum physics, stationary-state eigenfunctions and eigenvalues for one-dimensional potentials, interaction with the electromagnetic field, electronic conduction in solids, applications of quantum structures.

Student Learning Objectives/Outcomes

1. Demonstrate knowledge of the wavelike nature of fundamental particles.
2. Show the ability to solve the Schroedinger Wave Equation for simple bound-state and propagating-state problems
3. Demonstrate an understanding of dispersion relations and their impact on electron dynamics.
4. Demonstrate the ability to identify quantum systems which will behave irreversibly, and show how to use simple models to evaluate their transition rates.

Required Textbooks and Materials

Textbook: William R. Frensley, *Understanding Electron Devices* (an electronic work in progress, can be downloaded at:
http://www.utdallas.edu/~frensley/UndElDev/download/
Username: EE6319
Password: _____

Course Topics

Introduction
- Wave-Particle Duality
- Indeterminacy
- Schroedinger Wave Equation
- Time-Independent Schroedinger Eq.

Simple Solutions of the Schroedingner Equation
- Scattering by simple barriers
- Tunneling
- Probability currents
- Simple bound states.
- Square well

Quantum States and Operators
- Linear vector spaces
- Unitary and Hermitian Operators
- Dirac notation

Quantum Measurements
- Projections
- Expectation values and moments
- Commutators of Operators

Wave Packets and Uncertainty Relations

Analytic Solutions of the Schroedinger Equation
- Harmonic Oscillator
- Angular Momentum
- Hydrogen atom

Getting Results from Quantum Mechanics
- Expansions and matrix formulation
- Perturbation theory

Energy bands in solids
- Bloch theorem
- Methods of calculating bands
- The effective-mass approximation
- Dynamics of band electrons (group velocity theorem and acceleration theorem)

Irreversible processes
- Fermi Golden Rule

Equilibrium statistical mechanics
- Boltzmann distribution
- Fermi distribution
- Density of states
- Fermi level

Teaching Assistant:
Honglei Wang
Email: hxw113020@utdallas.edu
Office hours: Monday 5:30-7:00pm NSERL third floor.

Exams

There will be a midterm exam in early October.
There will be a final examination at the time designated by the University, most likely on Tuesday, Dec. 13, 2016 at 5:00 PM.

Grading Policy

Scoring coefficients:

Homework	20%
Midterm exam	30%
Final exam	50%

Course & Instructor Policies

Assignments and exams are due at the specified times. Absences due to work- or school-related travel must be approved in advance by the Professor.

Off-campus Instruction and Course Activities

None.

Comet Creed
This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do."

UT Dallas Syllabus Policies and Procedures

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.