Course Syllabus

Course Information

Course Number/Section	EEMF6319
Course Title	Quantum Physical Electronics
Term	Fall 2025

Professor Contact Information

Professor	Jie Zhou
Office Phone	(will be distributed by email to registered students)
Other Phone	(will be distributed by email to registered students)
Email Address	Jie.Zhou@UTDallas.edu
Office Location	ECSN 4.528
Office Hours	(Please email me and we will arrange a time)

Lectures: Tuesday and Thursday 2:30-3:45 PM in FN 2.202.

Course Pre-requisites, Co-requisites, and/or Other Restrictions
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). Textbook and lecture slides are accessible through ***eLearning***

This work contains interactive programs in Java that may be launched from the PDF textbook and lecture slide files. To make this work, you will need to use a PDF reader which permits a remote file launch action. The one that I know works is the free Foxit PDF viewer.
Go to File->Preferences->Trust Manager and deselect "Enable Safe Reading Mode."

Also, the Java Web Start protocol is used, though it has been discontinued by Oracle. This used to require installation of an older version of Java (1.7 or 1.8). We now use an open-source version of Web Start, which you will need to download and install from:
https://openwebstart.com/

Reference materials:
- David J. Griffiths, *Introduction to Quantum Mechanics*
- Charles Kittel, *Introduction to Solid State Physics*
- S. M. Sze et al., *Physics of Semiconductor Devices*

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

    - Electron spin and the periodic table
- 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)
- Equilibrium statistical mechanics
    - Boltzmann distribution
    - Fermi distribution
    - Density of states
    - Fermi level
- Irreversible processes
    - Fermi Golden Rule

Grading Policy

There will be assigned homework problems, a Midterm Exam, and a Final Exam. The scoring coefficients will be:

Homework	20%
Midterm exam	30%
Final exam	50%

(These may be adjusted by ±5% at the end of the semester to achieve more fairness in grading, if necessary.)

There will be a Mid-term Exam in October and a Final Exam at the time designated by the University.

The exams will be traditional, written, in-class exams.

Teaching Assistant:

(to be assigned)

Class Participation

Regular class participation is expected regardless of course modality. Students who fail to participate in class regularly are inviting scholastic difficulty. A portion of the grade for this course is directly tied to your participation in this class. It also includes engaging in group or other activities during class that solicit your feedback on homework assignments, readings, or materials covered in the lectures (and/or labs). Class participation is documented by faculty. Successful participation is defined as consistently adhering to University requirements, as presented in this syllabus. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

Class Recordings

The instructor may record meetings of this course. Any recordings will be available to all students registered for this class as they are intended to supplement the classroom experience. Students are expected to follow appropriate University policies and maintain the security of passwords used to access recorded lectures. Unless the Office of Student AccessAbility has approved the student to record the instruction, students are expressly prohibited from recording any part of this course. Recordings may not be published, reproduced, or shared with those not in the class, or uploaded to other online environments except to implement an approved Office of Student AccessAbility accommodation. If the instructor or a UTD school/department/office plans any other uses for the recordings, consent of the students identifiable in the recordings is required prior to such use unless an exception is allowed by law. Failure to comply with these University requirements is a violation of the Student Code of Conduct.

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."

Academic Support Resources

The information contained in the following link lists the University's academic support resources for all students.

Please go to Academic Support Resources webpage for these policies.

Please go to UT Dallas Syllabus Policies webpage for these policies.

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