

# Nanoelectronics

EE5320, Fall 2019

University of Texas at El Paso

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## Course Description:

In this course we will study key modern electronic devices from both broad and deep perspectives. Modern electronic devices possess dimensions at which the quantum mechanical behavior of matter starts to become manifested; usually at 100 nm. Moreover, many modern devices derive their advanced performance from the unique properties of heterostructures. This course therefore covers key nanoscale aspects of semiconductors, properties of heterostructures, and the utilization of these structures in electronic devices.

Equally important to detailed study of nanodevices is the study of trends of semiconductor devices. This broad study will give us a perspective as to what direction the technology is heading and also which problems are likely to be encountered in the future. These are the problems that must be solved in the short term so that progress in electronics can occur in the long term. We will follow the book by Hanson and expand and give supplementary material where needed.

## Course Topics:

Review of semiconductor fundamentals  
Classic and quantum waves and particles  
Quantum mechanics of electrons  
Free and confined electrons  
Band theory of solids  
Single-electron and few-electron phenomena and devices  
-Tunnel Junctions; Coulomb Blockade; Single-electron Transistor  
Many electron phenomena  
-Density of states; Quantum wells, Q-wires and Q-dots; Ballistic transport; Spin transport

## Learning Outcomes:

After completion of this course, students should be able to:

- Apply fundamentals of nanoscopic physics to nanoscale structures
- Analyze single-electron and few-electron phenomena in nanoscale devices
- Analyze many-electron phenomena in nanoscale devices

## Required Textbooks:

Fundamentals of Nanoelectronics, Hanson, Prentice Hall

Advanced Semiconductor Fundamentals, Pierret, Prentice Hall

## Evaluation:

	<u>Value</u>
Homework/Quizzes	25%
Exam I	25%
Exam II	25%
<u>Exam III</u>	<u>25%</u>
Total	100%

**Grading and Policies:**

A: 90%-100% B: 80%-89.99% C: 70%-79.99% D: 60%-69.99% F: 0-59.99%

Late course work will not be accepted. No make-up work will be given.

Incidents of academic dishonesty will be referred to the Director of Electrical Engineering and the Dean of Students. <http://studentaffairs.utep.edu/Default.aspx?alias=studentaffairs.utep.edu/dos>

**If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to [cass@utep.edu](mailto:cass@utep.edu), or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at [www.sa.utep.edu/cass](http://www.sa.utep.edu/cass).**