The University of Texas at Tyler
Department of Electrical Engineering

EENG 5310: Solid State Devices

Syllabus

Catalog Description:

The purpose of this course is to provide a detailed understanding of the operation of solid-state electronic devices, the principles describing charge transport in semiconductors, the physics of junctions, and FET based systems.

Prerequisites: EENG 4309

Credits: (3 hours lecture, 0 hours laboratory per week)

Text(s):

Ben Streetman and Sanjay Banerjee: Solid state Electronic Devices, 7th Edition, Prentices Hall (**required**)

Lecture notes, additional materials, and examples will be made available through Canvas.

Additional Material: Engineering paper, scientific calculator, MATLAB, and Excel

Course Coordinator: Shawana Tabassum

Topics Covered: (paragraph of topics separated by semicolons)

Topics emphasize the principles of semiconductor physics, including carrier dynamics, junction behavior, and MOS device operation.

Evaluation Methods: (only items in dark print apply):

1. Examinations
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Objectives[2]: By the end of this course students will be able to:

1. Demonstrate understanding of solid state devices, their general characteristics and design considerations [1]

2. Demonstrate understanding for Fermi level, electron state occupation probability, holes and electrons, effective mass, density of states, effective density of states, intrinsic concentration [1, 3, 5]
3. Apply Fermi electron and hole occupation rules to compute hole and electron carrier concentrations for extrinsic semiconductors [1, 3, 5]
4. Demonstrate understanding for impact of lattice scattering, impurity scattering, velocity saturation on charged carrier mobility and how both carrier types contribute to conductivity [1]
5. Compute nonequilibrium excess carrier concentrations and minority carrier lifetimes from recombination and generation theory of semiconductors [1]
6. Demonstrate understanding for Einstein relation, Law of Junction in obtaining diode current [1, 3, 5]
7. Compute electrical quantities related to PN junction, contact potential, current, capacitance [1, 3, 5]
8. Compute equilibrium and non-equilibrium electrical quantities and properties for metal semiconductor junctions (potential barrier, current, capacitance, rectifying or ohmic) [1, 3, 5]
9. Calculate flatband voltage and turn on voltage for MOS devices [1, 3, 5]
10. Demonstrate understanding of terms like inversion, accumulation and depletion as well as triode and saturation conditions in MOS IV characteristics [1, 3, 5]
11. Predict MOS device parameters from capacitance versus voltage measurements [1, 3, 5, 6]
12. Utilize the knowledge gained to design solid-state devices and systems [1, 3, 5, 6]
13. Demonstrate knowledge of terminology, concepts and awareness of current devices in order to communicate with others in the technical community [1, 3, 5, 6]
14. Use Matlab, Multisim, Labview, and/or Excel to illustrate concepts and solve for performance metrics of the designed systems [1, 3, 5, 6]

[2]*Numbers in brackets refer to method(s) used to evaluate the course objective.*

Relationship to Program Outcomes (only items in dark print apply)[3]: This course supports the following Electrical Engineering Program Outcomes, which state that our students will:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics [2-11];
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors [12-14];
3. an ability to communicate effectively with a range of audiences

4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions [12-14];
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [1-14]

[3] *Numbers in brackets refer to course objective(s) that address the Program Outcome.*

Prepared By:	Shawana Tabassum	Date:	19 August 2026