

The University of Texas at Tyler
Department of Electrical Engineering

EENG 5310: Solid State Devices

“Learning is a 2-way street. I also look forward to learning from you!”

Class Information

Time: 3:00 – 4:50 PM, Tue and Thu

Place: RBN

Course-Instructor

Shawana Tabassum, PhD

Office: RBN 2009A

Email: stabassum@uttyler.edu (preferred way of communication)

Response time: I try to respond to all emails within one business day. So, please be patient.

Student Hours: Wed 3-4 PM & Fri 3-4 PM (For additional hours *feel free to email me if the above times do not work for you*)

Course Website

<https://uttyler.instructure.com/courses/26301>

Lecture notes and assignments will be posted on Canvas

Textbook & Resources

Ben Streetman and Sanjay Banerjee: Solid state Electronic Devices, 6th Edition, Prentices Hall, 2006 (required)

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

Course 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 design of solid-state electronics based (e.g., FET based) system for biomedical applications.

Learning Objectives

Upon completion of this course, the students will be able to:

- Demonstrate understanding for Fermi Level, electron state occupation probability, holes and electrons, effective mass, density of states, effective density of states, intrinsic concentration,

- Compute hole and electron carrier concentrations for extrinsic semiconductors in exhaustion regime within constraint of applicability of Boltzman Approximation,
- Apply Fermi electron and hole occupation rules to predict degree of ionization of donor and acceptor dopants,
- Demonstrate understanding for impact of lattice scattering, impurity scattering, velocity saturation on charged carrier mobility and how both carrier types contribute to conductivity,
- Demonstrate an understanding for ohmic and diffusion currents and be able to calculate conductivity, resistance, sheet resistance and built-in field,
- Compute nonequilibrium excess carrier concentrations, quasi-Fermi Levels, minority carrier lifetimes from recombination and generation theory of semiconductors,
- Demonstrate understanding for Einstein relation, Law of Junction and Law of Detailed Balance play in obtaining diode current,
- Compute electrical quantities related to PN junction, contact potential, current, capacitance,
- Compute equilibrium and non-equilibrium electrical quantities and properties for metal semiconductor junctions (potential barrier, current, capacitance, rectifying or ohmic)
- Calculate flatband voltage and turn on voltage for MOS devices,
- Demonstrate understanding of terms inversion, accumulation and depletion as well as triode and saturation conditions in MOS IV characteristics,
- Predict MOS device parameters from capacitance versus voltage measurements,
- Develop FET-based biomedical circuits and systems,
- Demonstrate knowledge of terminology, concepts and awareness of current solid-state bio-systems in order to communicate with others in the technical community,
- Use Matlab, Multisim and Labview to illustrate concepts and solve for figures of merit of biomedical systems

Course Outline

The numbers in the right-hand column refer to the chapter numbers of the 6th edition of the Ben Streetman and Sanjay Banerjee text.

Week	Topics	6th Ed.
Week 1: August 23	Crystal properties and growth of semiconductors	1
Week 2: August 30	Atoms and Electrons	2

Week 3: September 6	Energy bands and charge carriers	3
Week 4: September 13	Energy bands and charge carriers Quiz 1	3
Week 5: September 20	Excess carriers in semiconductors	4
Week 6: September 27	Excess carriers in semiconductors Checkpoint 1 for project	4
Week 7: October 4	Junctions	5
Week 8: October 11	Exam review Midterm Exam	
Week 9: October 18	Junctions Checkpoint 2 for project	5
Week 10: October 25	Field effect transistors Quiz 2	6
Week 11: November 1	Field effect transistors Checkpoint 3 for project	6
Week 12: November 8	Bipolar junction transistors	7
Week 13: November 15	Bipolar junction transistors Checkpoint 4 for project	7
Week 14: November 22	Thanksgiving Break	
Week 15: November 29	Final project presentations and Final exam review	
Week 16: December 6	Final exam	

Grade Distribution

The overall distribution of grades is obtained as:

Quizzes (2)	10%
Project	40%
Midterm Exam	25%
Final Exam	25%
Total	100%

Grading Scale

Letter Grades	Range (in %)
A	89-100
B	77-88
C	65-76
D	53-64
F	52 and below

Any deviation from the above policy such as scaling or curving to calculate the individual item or final scores will be at the sole discretion of the instructor and performed by the instructor uniformly for all students in the class.

Course Policies

Attendance Policy:

The progressive nature of the class means that perfect attendance is recommended if a good grade is desired. Makeup quizzes, exams or projects will only be provided for valid absences and at the sole discretion of the instructor.

Course communication:

Course communication will take place by e-mail and by announcements on UT-Tyler's Learning Management System (LMS). University policy requires that official e-mail communication be sent only to Patriot e-mail accounts.

Project Policy:

- There will be four checkpoints for the project. Please check the course outline above for their due dates.
- You will have to give presentations at each checkpoint and during the final presentation week. You need to submit a final report/poster.

You are always welcome to discuss with your peers regarding the submissions. However, do NOT copy, paste and use materials from your peers. That will be counted as PLAGIARISM.

All resources, including materials obtained from internet, should be properly acknowledged.

Grading Criteria

This project weighs 40% of the final grade.

Simulation and layout	25%
Experimental results	25%
Presentation and report	20%
Understanding	10%
Creativity and originality of the project	10%
Peer evaluation	10%

Quiz & Exam Policy:

- Quiz and exams will be closed book/note and no collaboration is allowed
- There will be one midterm and one final exam (check the course outline above)
- Review sessions for the midterm and final will be held during the class time

Late assignments and make-up policy:

Accommodation of the following absences will be ensured.

1. Extra-curricular activities as a representative of UT Tyler (e.g., sponsored sports, band, conference presentations, etc.).
2. Military service (including National Guard, ROTC).
3. Officially mandated court appearances (including jury duty).

In all cases, the person or agency responsible for the event or activity should provide participants with a letter explaining the proposed absence and its duration, including travel times for off-campus events and activities. Students must provide this documentation to instructors **at least two weeks prior** to the activity or event, except when such notice is not possible.

Other Absences Granting requests for accommodating other absences is at the discretion of the instructor. That is, the instructor will review the situation in an effort to provide a reasonable accommodation and arrange for possible make-up when possible to do so, without fundamentally altering a course or creating an undue burden for the instructor or department. Official documentation is required whenever possible and must be provided at the earliest opportunity. This policy is intended primarily for the following situations:

4. Medical excuse.
5. Family emergency.
6. Religious observances and practices. Students who request religious accommodation should do so in writing during the first week of the semester. Students may seek assistance from Dean of Students Office.

Expected online or classroom behaviors:

Students are highly encouraged to be considerate.

- **Be respectful:** Please be respectful. Do not say anything that includes attacking someone, dominating a discussion, controlling the class agenda, etc.
- **Be a responsible citizen:** Please do not engage in activities that is disruptive to the rest of the class. The instructor should also take into consideration complaints of disruptive behavior brought to their attention by students. Should any student officially enrolled for credit or audit in a class disrupt the instructor's ability to ensure a safe environment and/or deliver the approved curriculum, the instructor has the right to ask that the disruptive action cease immediately. The responsible student should cease the disruption and utilize non-disruptive means for expressing disagreement or concern. If the disruption continues, the instructor can pursue various forms of intervention, including suspension from class and use of student disciplinary regulations.

Campus resources:

- UT Tyler Writing Center (903.565.5995), writingcenter@uttyler.edu , <https://www.uttyler.edu/writingcenter/onlinetutoringinfo.php>
- UT Tyler Tutoring Center (903.565.5964), tutoring@uttyler.edu
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- UT Tyler Academic Advising, <https://www.uttyler.edu/advising/>
- UT Tyler Counseling Center (903.566.7254), <https://www.uttyler.edu/counseling/>
- UT Tyler Canvas support, <https://www.uttyler.edu/canvas/>. See below for more information
- UT Tyler Technology support, <https://www.uttyler.edu/ccs/>
- UT Tyler Student Accessibility and Resources, <https://www.uttyler.edu/disabilityservices/>
- UT Tyler Library support, <https://www.uttyler.edu/library/>
- UT Tyler PASS Tutoring Center, <https://www.uttyler.edu/tutoring/>
- UT Tyler Veterans Resources, <https://www.uttyler.edu/military-and-veterans-success-center/?r=/veteransaffairs/>
- UT Tyler Student Health and Wellness, <https://www.uttyler.edu/wellness/onlineresources.php>

Academic Misconduct

Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

i. “Cheating” includes, but is not limited to:

- copying from another student’s test paper;
- using, during a test, materials not authorized by the person giving the test;
- failure to comply with instructions given by the person administering the test;
- possession during a test of materials which are not authorized by the person giving the test, such as class notes or specifically designed “crib notes”. The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
- using, buying, stealing, transporting, or soliciting in whole or part the contents of an unadministered test, test key, homework solution, or computer program;
- collaborating with or seeking aid from another student during a test or other assignment without authority;
- discussing the contents of an examination with another student who will take the examination;

- divulging the contents of an examination, for the purpose of preserving questions for use by another, when the instructors has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
- substituting for another person, or permitting another person to substitute for oneself to take a course, a test, or any course-related assignment;
- paying or offering money or other valuable thing to, or coercing another person to obtain an unadministered test, test key, homework solution, or computer program or information about an unadministered test, test key, home solution or computer program;
- falsifying research data, laboratory reports, and/or other academic work offered for credit;
- taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
- misrepresenting facts, including providing false grades or resumes, for the purpose of obtaining an academic or financial benefit or injuring another student academically or financially.

ii. “Plagiarism” includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another’s work and the submission of it as one’s own academic work offered for credit.

iii. “Collusion” includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.

iv. All written work that is submitted will be subject to review by plagiarism software.

University Policies

People learn differently, and our goal is to ensure everyone is learning, regardless of their needs. We will make every effort to accommodate the needs of students with different learning abilities.

UT Tyler Honor Code:

Every member of the UT Tyler community joins together to embrace: Honor and integrity that will not allow me to lie, cheat, or steal, nor to accept the actions of those who do.

Students Rights and Responsibilities:

To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link: <http://www.uttyler.edu/wellness/rightsresponsibilities.php>

Campus Carry:

We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at <http://www.uttyler.edu/about/campus-carry/index.php>

UT Tyler a Tobacco-Free University:

All forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors.

Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products.

There are several cessation programs available to students looking to quit smoking, including counseling, quitlines, and group support. For more information on cessation programs please visit www.uttyler.edu/tobacco-free.

Grade Replacement/Forgiveness and Census Date Policies:

Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions of which students need to be aware. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

State-Mandated Course Drop Policy:

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the

extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

Disability/Accessibility Services:

In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Texas at Tyler offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including a non-visible diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of modifications or accommodations in a previous educational environment, you are encouraged to visit <https://hood.accessiblelearning.com/UTTyler> and fill out the New Student application. The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with Cynthia Lowery, Assistant Director of Student Services/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at <http://www.uttyler.edu/disabilityservices>, the SAR office located in the University Center, # 3150 or call 903.566.7079.

Social Security and FERPA Statement:

It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation:

Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.

Canvas for Students at UT Tyler

Getting Started:

1. Be sure to have a UT Tyler username. If you do not, please visit Passwords and Accounts (<https://www.it.iastate.edu/services/accounts>)
2. Login to [Canvas](#) with your UT Tyler username and password and look for your course for this semester.

General Help with Canvas:

In your Canvas course page, on the global navigation on the left panel, you will see a Help Tab. Clicking on that will take to various available options. Generally, you have:

- [Canvas Live Chat](#) – 24*7 live chat with Canvas specialists

- [Canvas Guides](#)-a repository of how-tos
- [Ask the Canvas Community-Online support forum for canvas users.](#)

Visit [UT Tyler Canvas support](#) if your questions are not answered