

Syllabus EE 4329/5340 Semiconductor Device Theory (Fall 2016)

Instructor: Dr. Weidong Zhou

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Office Hours: T/Th 2 pm -3 pm

Course Number, Section Number, and Course Title: EE 4329/5340 Semiconductor Device Theory

Time and Place of Class Meetings: T/Th 3:30 pm - 4:50 pm SH105

Description of Course Content:

EE4329: Introduction to semiconductors in terms of atomic bonding and electron energy bands. Equilibrium statistics of electrons and holes. Carrier dynamics; continuity, drift, and diffusion currents; generation and recombination processes, including important optical processes. Introduction to P-N junctions, metal-semiconductor junctions, light detectors and emitters; bipolar junction transistors, junction and Metal-Oxide Semiconductor Field-Effect Transistors (MOSFETs). Prerequisite: Grade of C or better in EE 3444.

EE5340: Quantum mechanics applicable to semiconductor theory. Energy band theory, density of states and effective mass theory. Intrinsic and extrinsic semiconductors, equilibrium statistics for electrons and holes. Transport, generation and recombination of excess carriers. Device equations and physics. Theory and performance of p-n and Schottky diodes, bipolar and MOS transistors.

Student Learning Outcomes: (1) Understanding of semiconductor and electronic device physics and operation principles; (2) Apply the device models to the design of integrated circuits.

Requirements: Prerequisite: EE 3444

Required Textbooks and Other Course Materials:

1. R. F. Pierret, *Semiconductor Device Fundamentals*, Addison-Wesley, 1996.

References:

1. R.S. Muller and T.I. Kamins, *Device Electronics for Integrated Circuits*, 3rd Ed., John Wiley and Sons, Inc., New York, NY, 2003.
2. S. M. Sze, *Semiconductor Devices Physics and Technology* (2nd Ed.), Wiley, 2002.
3. H.C. Casey, Jr., *Devices for Integrated Circuits*, John Wiley & Sons, Inc., New York, NY, 1999.
4. S. Franco, *Design with Operational Amplifiers and Analog Integrated Circuits*, 3rd Ed., The McGraw-Hill Companies, Inc., New York, NY, 2001.

Descriptions of major assignments and examinations with due dates:

- Homework (0%): Assigned and self-graded
- Quiz: 5%
- Midterm: 40%
- Final: 55%

Attendance: attendance is required.

Grading Policy:

A ($\geq 85\%$); B ($\geq 70\%$ to $< 85\%$); C ($\geq 60\%$ to $< 70\%$); D ($\geq 50\%$ to $< 60\%$); F ($< 50\%$).

Attendance Policy: Attendance is required. Students are responsible for all materials covered in class.

Drop Policy: As per University guidelines. See the Registrar's Bulletin or the University Calendar in the front part of the UTA catalog for drop dates.

Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a **letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting: **The Office for Students with Disabilities, (OSD)** www.uta.edu/disability or calling 817-272-3364. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.*

Title IX Policy: The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.*

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington’s tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents’ Rule* 50101, §2.2, suspected violations of university’s standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student’s suspension or expulsion from the University. Additional information is available at <https://www.uta.edu/conduct/>.

Make-up Exam Policy:

There will be absolutely no late or make-up mid-term or final examination given unless a written request has been submitted to and approved by the instructor at least two weeks prior to the examination date. As a rule, make-up examinations are several orders of magnitude more difficult than examinations given on the scheduled dates. Please be advised that illness or any other absence on the examination date does not constitute a valid reason for a make-up examination.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after

graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as “lecture,” “seminar,” or “laboratory” are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student’s feedback via the SFS database is aggregated with that of other students enrolled in the course. Students’ anonymity will be protected to the extent that the law allows. UT Arlington’s effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: for semester-long courses, a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include [tutoring](#), [major-based learning centers](#), developmental education, [advising and mentoring](#), personal counseling, and [federally funded programs](#). For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at <http://www.uta.edu/universitycollege/resources/index.php>.

The IDEAS Center (2nd Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

The Library’s 2nd floor Academic Plaza offers students a central hub of support services, including IDEAS Center, University Advising Services, Transfer UTA and various college/school advising hours. Services are available during the library’s hours of operation. <http://library.uta.edu/academic-plaza>

The following is an excerpt from the College of Engineering's statement on Ethics, Professionalism, and Conduct of Engineering Students. Read the statement carefully, sign it, and return it to your instructor. You are being provided with a copy for your records. Additional copies of this statement can be obtained from your instructor or the Office of the Dean of Engineering.

**STATEMENT ON ETHICS, PROFESSIONALISM, AND CONDUCT
FOR ENGINEERING STUDENTS**

COLLEGE OF ENGINEERING
THE UNIVERSITY OF TEXAS AT ARLINGTON

The College cannot and will not tolerate any form of academic dishonesty by its students. This includes, but is not limited to cheating on examination, plagiarism, or collusion.

Cheating on an examination includes:

1. Copying from another's paper, any means of communication with another during examination, giving aid to or receiving aid from another during examination;
2. Using any material during examination that is unauthorized by the proctor;
3. Taking or attempting to take an examination for another student or allowing another student to take or attempt to take an examination for oneself.
4. Using, obtaining, or attempting to obtain by any means the whole or any part of an un-administered examination.

Plagiarism is the unacknowledged incorporation of another's work into work which the student offers for credit.

Collusion is the unauthorized collaboration of another in preparing work that a student offers for credit.

I have read and I understand the above statement.

In addition, I understand that, in order to ensure fairness to all students, exams will be proctored and possibly videotaped.

Course number: _____

Student's signature: _____ Date: _____

Student's name, printed: _____

Student's ID number: XXX-XX-_____

Tentative Course Schedule (2016)

Class Schedule

EE4329/5340, Fall 2016

Zhou

| Week | Date | Topics | |
|------|------------|---|-------|
| 1 | 8/25/2016 | Intro/Semiconductors | |
| 2 | 8/30/2016 | Bandgap, | HW#1 |
| | 9/1/2016 | (Travel) | |
| 3 | 9/6/2014 | effective mass, DOS, Fermi levels, Carrier Statistics | |
| | 9/8/2014 | Carrier Action (Drift/Diffusion) | HW#2: |
| 4 | 9/13/2014 | PN Junction/ Heterostructures | |
| | 9/15/2014 | Continuity Equation IV | |
| 5 | 9/20/2014 | IV/CV | |
| | 9/22/2014 | (Travel) | |
| 6 | 9/27/2014 | Non-ideal diode and device process | |
| | 9/29/2014 | | |
| 7 | 10/4/2014 | MS Junctions | |
| | | | HW#3: |
| 8 | 10/11/2014 | Midterm Exam | |
| | 10/13/2014 | BJT | HW#4: |
| 9 | 10/18/2014 | | |
| | | BJT | |
| 10 | 10/25/2014 | Review/MOS-C | |
| | 10/27/2014 | MOS-C | HW#5: |
| 11 | 11/1/2014 | (Travel) | |
| | 11/3/2014 | (Travel) | |
| 12 | 11/8/2014 | MOSFET | |
| | 11/10/2014 | | |
| 13 | 11/15/2014 | | |
| | | MOSFET | |
| 14 | 11/22/2014 | | HW#6 |
| | 11/24/2014 | Thanksgiving Holiday (No Class) | |
| 15 | 11/29/2014 | (Travel) | |
| | 12/1/2014 | Review | |
| 16 | 12/6/2014 | Last day of class? | |

As the instructor for this course, I reserve the right to adjust this schedule in any way that serves the educational needs of the students enrolled in this course. –Weidong Zhou