Tel Aviv University
Faculty of Engineering
School of Electrical Engineering

אוניברסיטת תל אביב
הפקולטה להנדסה
בית הספר להנדסת חשמל

Electronic Devices

Spring Semester, 2016

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COURSE DESCRIPTION

The main goal of the course is to apply the principles of semiconductor physics in the analysis and understanding of several semiconductor-based devices: Diodes, Bipolar Junction Transistors, MOS capacitors, and MOSFETs.

COURSE TOPICS

Week 1:
-Density of States, Fermi-Dirac distributions, Fermi Function and Fermi level
- Applying Fermi to semiconductors, energy band diagrams

Week 2:
-PN Junctions at equilibrium: Energy band diagrams, potential, space charge and field in the depletion region - Poisson's Equation

Week 3:
-PN Junctions at equilibrium: Depletion Approximation, 1-Sided junctions
-Start Biasing of PN Junctions: Forward and Reverse Biased Junctions

Week 4:
- Biasing of PN Junctions: Forward and Reverse Biased Junctions
--Carrier profiles

Week 5:
-Current in PN Junctions
-Diffusion Current and Drift Current component
-Current-voltage (I-V) characteristics: Diode equation

Week 6:
-Practical considerations in PN-Junctions
-Introduction to Optoelectronic Devices: Photodiodes, Solar cells, LEDs
-Optimization

Week 7:
-MOS Capacitors - Energy Band Diagram

Week 8:
-MOS Capacitors - Flatband, Accumulation, Depletion, Inversion, Threshold Voltage
-Voltage Drops in a MOS

Week 9:
-Small Signal Capacitance Model - C-V characteristic. Low Frequency, High Frequency measurements
-MOS field effect transistor (MOSFET). NMOS and PMOS.

Week 10:
-MOSFET Operating Principles
-MOS Analysis
-Gradual Channel Approximation

Week 11:
-MOS Current-Voltage Characteristics
-MOS Short Channel Effects

Week 12:
-Bipolar junction transistor (BJT) – electrostatic description and device design. Ideal BJT in forward active mode. Minority diffusion currents in narrow vs. wide base. BJT in various configurations, dc current and voltage gains.

Week 13:
-BJT Device Optimization

ASSIGNMENTS

Homeworks counts for **15%** of the total grade. Collaboration is encouraged but you must do your own work! Late homework will not be accepted, unless a special exemption is approved by the instructor prior to the due date.

MIDTERM COURSE POLICY

The midterm counts for **20%** of the total grade.

FINAL COURSE POLICY

The final exam will cover the entire course material and will count for **65%** of the total course grade. The duration will be 3 hours. During an examination, student shall not use books, papers, or other materials not authorized by the instructor.

Students will have a first exam, Moed A. If the student does not pass, they can retake the exam, Moed B. The last exam taken will be the student's final grade for the exam.

REQUIRED READING

Streetman, B. *Solid State Electronic Devices*

ADDITIONAL READING

Bar-Lev, A. *Semiconductor and Electronic Devices*
S. M. Sze, *Physics of Semiconductor Devices*
Kittel, C. (2005). *Introduction to solid state physics*.