UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering and Computer Sciences

Professor Ali Javey
550B Cory Hall, ajavey@berkeley.edu

INTEGRATED CIRCUIT DEVICES
EE130/EE230A, Fall 2017

T.A.:

Matin Amani (mamani@berkeley.edu)

LECTURES

TuTh 9:30-11:00 am, 534 Davis

DISCUSSIONS

W 11-12, 299 Cory
W 12-1, 299 Cory

T.A. will review important concepts covered in the lectures, lead the discussion of homework, work through sample problems, and present supplementary materials.

OFFICE HOUR

Professor and T.A.'s office hour will be announced on EE130/230 homepage.

TEXT

C. Hu, *Modern Semiconductor Devices for Integrated Circuits*.

REFERENCES

1. R. S. Muller and T. I. Kamins with Mansun Chan, *Device Electronics for Integrated Circuits*, 3rd Edition; Wiley and Sons, Publisher.
2. B. L. Anderson and R. L. Anderson, *Fundamentals of Semiconductor Devices*, McGraw-Hill.
3. R. F. Pierret, G. W. Neudeck, Modular Series on Solid State Devices, Vol. 1, 2, 3, 4, 7. (Many students found this series to be very helpful. It is written in clear language.)
4. R. F. Pierret, *Semiconductor Device Fundamentals*, Addison Wesley, 1996.
5. A. S. Grove, *Physics and Technology of Semiconductor Devices*. (This book also excels in clear explanations)
6. B. G. Streetman and S. Banerjee, *Solid State Electronic Devices*, Prentice Hall (Best selling text in its field, this book is at a lower level of difficulty than the others)

COURSE OBJECTIVE

a. To develop a physical understanding of three important devices: the pn junction, the MOS transistor, and the bipolar transistor.
b. To explore the general skills for analyzing and designing semiconductor devices.

PREREQUISITES

Physics 7B or equivalent

RELATION TO OTHER COURSES

EE 105 – The first four weeks of EE 105 presents a preview or a condensed version of EE 130/230A.
EE 130/230A is a prerequisite for EE 230B (Solid State Devices).
EE 130/230A is also helpful (but not a prerequisite) for IC analysis and design courses such as EE 140, 150, and 142, as well as for the microfabrication technology course EE 143.

CONTENTS:

A. Review of Semiconductor Properties (2-3 weeks)
   Bond picture, electrons, holes, band picture, density of states, electron statistics, Fermi level, mobility, diffusion, and recombination.
B. Fabrication Technology (1 week)
   Crystal growth, thermal oxidation, lithography and pattern transfer, dopant addition and diffusion, and chemical vapor deposition.
C. PN Junction (3 weeks)
   Field and potential in step PN junctions, minority and majority currents, junction capacitance, device model, SCL generation and recombination current.
D. Metal-Semiconductor Contact (1 week)
   Energy diagram at interface, I-V characteristics, ohmic contact.
E. MOS Devices (4 weeks)
   MOS diodes, flat-band, enhancement, depletion, inversion, CCS, MOSFET I-V characteristics, speed, device model, MOS technology, memory, and CMOS.
F. Bipolar Transistor (2 weeks)
   Structure and operation, emitter and base efficiencies, current gain, transit time, device model, built-in field, regions of operations, Ebers-Moll model, IC transistors.

HOMEWORK, EXAM & GRADES

Homework will be assigned every **Thursday** and will be due the following **Thursday** in class. Discussion and collaboration, as opposed to copying, of homework is encouraged. In other words, you are encouraged to discuss the homework with your classmates but you must write your own derivations and do your own calculations, etc. We encourage cooperation rather than competition. Copying someone else's work is considered cheating and will result in severe consequences.
Percentages are as follows:

Homework	15%
Two Midterm Exams	20% (each)
Design Project	15%
Final Exam	30%
"Bonus" Quizzes	

EECS Department Policy on Academic Dishonesty:

http://www.eecs.berkeley.edu/Policies/acad.dis.shtml

EECS Department Grading Guidelines:

http://www.eecs.berkeley.edu/Policies/ugrad.grading.shtml

EE130/230A Course Website:

bcourses