

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

Prof. Chenming Hu
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INTEGRATED CIRCUIT DEVICES
EECS130 Spring 2006

T.A.s:

Anupama Bowonder, bowonder@eecs.berkeley.edu
TBA

LECTURES

Tuesday and Thursday – 3:30 to 5:00pm in 3106 Etcheverry

DISCUSSIONS

Section 101–Wednesday 8-9am, 247 Cory
Section 102 – Thursday 5-6pm, 289 Cory

Each student must attend one of these sections. T.A.s will review important concepts covered in the lectures, lead the discussion of homework, work through sample problems, and present supplementary materials.

OFFICE HOUR

Professor Hu: Tuesday 5-6pm, 502 Cory Hall (Office Hour)
Wednesday 5:30-6:30, Hogan Room, 535 Cory Hall (Question/Answer Session)
Anupama: TBA

TEXT

Reader for purchase at Copy Central @ 2483 Hearst Ave. (near Euclid)

REFERENCES (On reserve at the Engineering Library)

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

EECS 40 or EECS 100: Simple pn-junction and MOSFET theory and MOSFET circuit applications. It is assumed that the students know the concept of energy levels in hydrogen atoms.

RELATION TO OTHER COURSES

EECS 105 – The first four weeks of EECS 105 presents a preview or a condensed version of EECS 130

EECS 130 is a prerequisite for the following courses:

EECS131: Semiconductor Electronics (may be taken concurrently)

EECS231: Solid State Devices

EECS 130 is also helpful (but not a prerequisite) for IC analysis and design courses such as EECS 140, 141, and 142, as well as for the microfabrication technology course EECS 143

CONTENTS:

- A. Review of Semiconductor Properties (2 weeks)
Band 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. MOS Devices (4 weeks)
MOS diodes, flat-band, enhancement, depletion, inversion, CCS, MOSFET I-V characteristics, speed, device model, MOS technology, memory, and CMOS.
- E. Metal-Semiconductor Contact (1 week)
Energy diagram at interface, I-V characteristics, ohmic contact.
- F. Bipolar Transistor (3 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. Do not hesitate to ask Prof. Hu and or the T.A.s for clarifications and hints for the homework problems during Discussion Session and Office hours. We encourage cooperation rather than competition. Percentages are as follows:

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|-------------------|------------|
| Homework | 20% |
| Two Midterm Exams | 20% (each) |
| Design Project | 15% |
| Final Exam | 25% |

EECS Department Policy on Academic Dishonesty:

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

EE 130 Home Page: <http://www-inst.eecs.berkeley.edu/~ee130>
EE 130 News Group: ucb.class.ee130