UCSD Jacobs | Electrical and Computer Engineering

ECE 103 Fundamentals of Devices and Materials
Fall 2013, Sept. 23 - Dec. 14

Instructor: Prof. Shadi A. Dayeh
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Office Hours: Tuesday 3:00 - 4:00 pm; Friday 10:00 - 11:00 am or by appointment/drop in.
Assistant: Cheryle Wills, 3600 Pod, EBU1. Tel.: (858) 534-2498, e-mail: clwills@ucsd.edu

Lectures: Tuesday, Thursday, 12:30 - 1:50 pm Warren Lecture Hall (WLH), Room 2005.

Discussion Sessions: Monday, Wednesday 12:00-12:50pm Pepper Canyon Hall (PCYNH), Room 122.

Teaching Assistants:

- Farid Azzazi, e-mail: faridazzazy@gmail.com
  Discussion Sessions: M 12:00 – 12:50 pm, PCYNH, starting Sept. 30
  Office Hours: Thursday 3:00-4:00pm. Friday 3:00am-4:00pm, EBU1, Room (TA ROOM).
- Somayeh Imani, e-mail: imani@ieee.org
  Discussion Sessions: W 12:00 – 12:50 pm, PCYNH
  Office Hours: Monday & Wednesday 5:00-6:00pm, EBU1, Room (TA ROOM).

Grading:	8 Homeworks	20%	Due usually on Thuesdays, Oct. 8, 15, 22, 29, Nov. 5, 12, 19, 26, Dec. 3 in class at the beginning of the lecture.
	Midterm	20%	One Hour, Thursday, Oct. 31
	2 Quizzes	20%	Half an hour; Tuesdays, Oct. 15, Nov. 12
	Final	40%	Friday, Dec.13 11:30 - 2:29 pm

Recommended Textbook: Robert F. Pierret, *Semiconductor Device Fundamentals*, (Addison- Wesley, 1996).

Additional References:

Simon M. Sze, *Semiconductor Devices: Physics and Technology*, 2nd Edition, (John Wiley and Sons), 2002.

Donald A. Neamen, *Semiconductor Physics & Devices,* 3rd Edition, (McGraw-Hill), 2002.

Robert F. Pierret, *Advanced Semiconductor Fundamentals*, 2nd Edition, (Prentice Hall) 2002.

Simon M. Sze, *Physics of Semiconductor Devices*, 3rd Edition, (John Wiley and Sons), 2006.

Please look up homework sets, homework solutions, and announcements in the ECE Class Website, http://iebl.ucsd.edu/ece103 periodically.

Course Policy:

Exams: Quizzes, Midterm and Final are closed book, closed notes, no electronic devices such as laptops, iPads, cell phones, PDAs, etc… ***Allowed Items: Pen/Pencil, Calculator & Blue Book.*** One sheet 8.5"x11" (1 page) is allowed for midterm and (2 pages) for Final. Please follow Instructor/TA instruction during exams. In Addition, students must adhere to class Integrity Policy below. Rescheduling of quizzes and exams under extreme circumstances with compelling and well-documented reasons will be allowed with notice to the instructor in advance of the exam date.

Grading: Grades will be assigned based on your overall performance in the class. Please see Instructor for exam regrades. The whole exam may be regarded and the overall exam grade may increase or decrease.

Homework: Discussion of ECE103 course material and homework are allowed. However, every student should write his/her own homework. Use of previous exams, homework sets, copying from classmates, allowing others to copy, working out the homework problems together are forbidden. Homework sets are to be posted on the class website and extensions are not allowed except for extremely exceptional reasons.

Integrity Policy: Academic integrity is a serious and an important matter that you should practice throughout your education at UCSD and thereafter. You are expected to complete the homework sets, quizzes and exams based on the course standards defined above. Any attempt to receive a grade by means other than your own individual and honest effort and any kind of unauthorized aid will be considered a violation for the course Integrity Policy. Any case of Academic Misconduct will be reported to the Academic Integrity Coordinator and your college Dean. You are responsible to follow UCSD's Policy on Academic Integrity found at:
http://senate.ucsd.edu/manual/appendices/appendix2.pdf
Please consult with the course instructor shall you have any questions on the above.

Course Outline
Preliminary Schedule

Sept. 26: Introduction to ECE103 + energy bands in solids: Hydrogen atom, H_2^+ molecule.
Oct. 1: Shockley picture of energy bands, energy-momentum (E-k) diagrams, crystal structure.

Oct. 3: Chapter 1 (all sections), semiconductor crystal structure, miller indices. Chapter 2 (Sections 2.1, 2.2) electrons and holes and their effective masses.

Oct. 8, 10: Chapter 2 (sections 2.3-2.6), carrier modeling and statistics: density of states, Fermi function, intrinsic and doped semiconductors, equilibrium carrier concentration, charge neutrality, temperature dependence.

Oct. 15 (Quiz #1), 17: Chapter 3 (all sections), transport in semiconductors: drift, diffusion, recombination-generation, continuity equations.

Oct. 22, 24, 29: Chapters 5, 6 (all sections), p-n Junctions: Poisson's equation, energy band-edge bending, built-in potential, depletion widths, biased junctions, boundary conditions, current equations, deviation from ideal, small signal and transient response (Chapters 7, 8).

Oct. 31: Midterm

Nov. 5, 7, 12: Chapters 10 (All Sections), bipolar junction transistors: npn, pnp, energy band-edge diagrams, boundary conditions, transistor action, Ebers-Moll equations and model, base width modulation, punch through, introduction to graded base and heterojunction BJTs.

Nov. 14, 19: (Sze, Semiconductor Devices: Physics and Technology, Chapter 7, Sections 7.1, 7.2) Metal semiconductor contacts, Schottky and ohmic contacts, Metal Semiconductor Field Effect Transistors (MESFETs).

Nov. 21, 26, Dec. 3: Chapters 16-19, Metal Oxide Semiconductor (MOS) Capacitors and Metal Oxide Field Effect Transistors (MOSFETs): Energy band-edge diagrams, threshold voltage, capacitance voltage characteristics, current voltage characteristics. Non-ideal MOS considerations, Short channel effects, structure of modern MOSFET devices.

Dec. 5: Review