

Course Intro and Background

Prof. Jason Heikenfeld

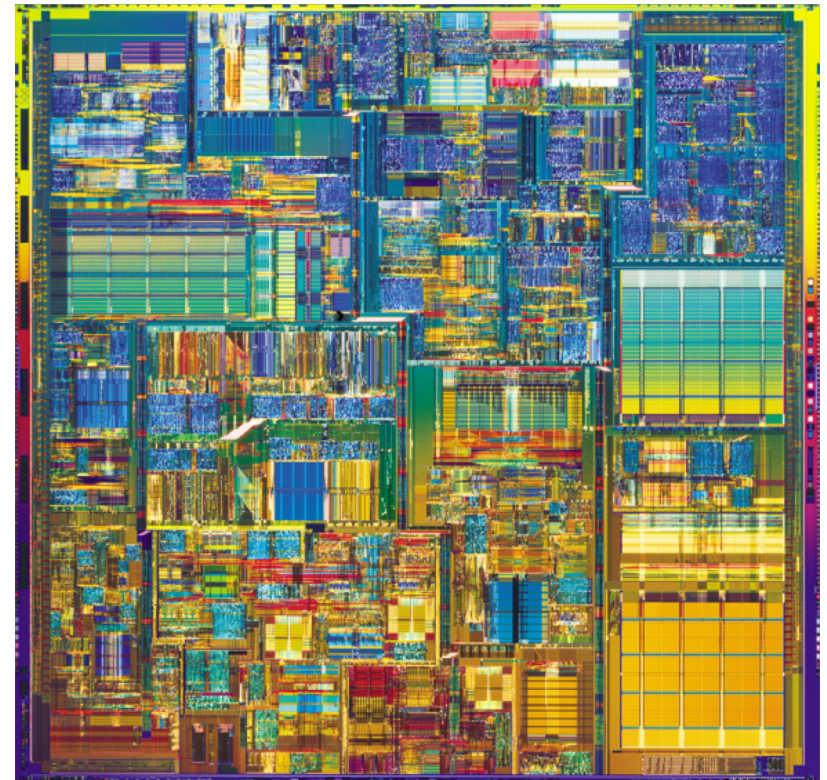
824 Rhodes Hall

556-4763

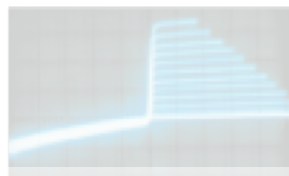
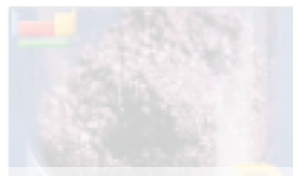
heikenjc@ucmail.uc.edu

<http://www.ece.uc.edu/devices/>

- ▶ Office hours: M-F around 9 AM, *anytime if I am free, but is best if you schedule an appt. by email!*
- ▶ Email is great, and the best way to reach me 7 days/week! Video Skype name is 'heikenfeld'



www.tayloredge.com/museum/processor/processorhistory.html



▶ Course Approach – ‘The Flipped Classroom’

Lecture? You do outside of class (videos), and when you come to class there is a quiz... After the quiz I will answer questions on lecture, then we will start on...

Homework? We do it in class together! There will be several problems we do as a group, and the rest you can do during class if your group gets ahead, or do outside of class.

The videos are large, so download at UC or do streaming. You can re-compress them to smaller file sizes on your own, if you choose to.

▶ Grading

Daily Quizzes		20%	<u>We will drop the lowest 3.</u>
Homework		10%	
Test #1	60 min	15%	Diodes – Is Critical for Whole Class!
Test #2	60 min	15%	BJTs + Comprehensive
Test #3	60 min	15%	FETs + Comprehensive
Exam #4	60 min x 2 days	25%	Optoelectronics + Comprehensive

Each test will also become more and more comprehensive.

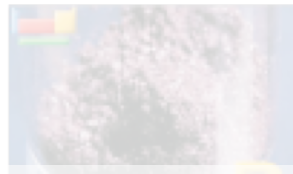
▶ Make Up Policy: No makeup tests or late homework without proof of tragedy, illness, or photos of supernatural events... Homework is due BEFORE class starts. No late homework accepted.



- ▶ Syllabus is on blackboard...
- ▶ I give you the HW solutions (it is NOT fair for some folks to get old solutions and others to not). HW is graded based on completion (not checked). You can check your own answers. **DO THE WORK! IF YOU DON'T, TRUST ME, YOU WONT PASS THE COURSE!**
- ▶ MATLAB - For all MATLAB problems, you may collaborate.

I don't care if people use variations of each others code (don't outright copy though). I would rather we cooperate and find the most efficient code, and we all therefore become comfortable with best practices.

- ▶ Each class we will:
 - (1) short quiz on the online lectures
 - * quiz is online, you need to be logged into blackboard before class starts!
 - (2) review anything NOT clear in the online lecture, ASK ME!!!
 - (3) start the problem set together
 - (4) problem solutions are already posted, but don't use them unless all else fails!



▶ Test Format:

Emphasis on concept questions, definitions, comparisons. However, quantitative problems & equations will be used where such exercises are needed to test mastery.

You can bring 1 side of 1 page to 1st test.

You can bring 1 side of 2 pages to 2nd test.

You can bring 1 side of 3 pages to 3rd test.

You can bring 1 side of 4 pages to 4th exam.

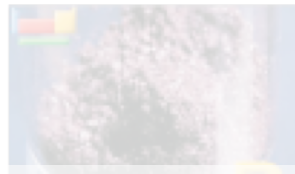
These pages may contain anything... *This allows me to test whether you really understand key concepts:*

1) *this is not a memorization contest*

2) *you will have your book as a reference long term*

Calculation style questions will be like your homework, or examples covered in class.

Each time, remind me to give you the last few years of tests! Students learn a ton as they go through practice tests (easy way to get you to do more homework :).



▶ Text Book

B.G. Streetman and S. Banerjee

*Solid State Electronic Devices, 6th Ed.**Don't sell back! Is your best long-term reference!*

▶ Need a second explanation? Some students might get this from the library...

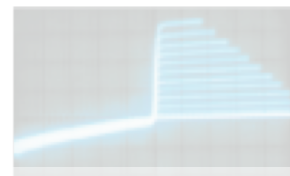
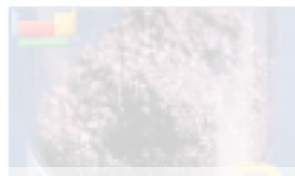
D. A. Neamen

Semiconductor Physics and Devices

▶ The textbook for 2077 can be found on Amazon used (\$40) or new (\$100-160):

▶ You do not explicitly need the book, and I have created all the homework problems. However, most of you will find it to be: (1) helpful during the course if something is not clear. (2) your best long-term reference for this course.

▶ All my equations and diagrams are consistent with how the textbook presents the material as well.



Policy for teams in class: Groups of 3 ideally, no less than 2 per group.

You must have one new face in your group each week (a 'new face' should not have been in your group for at least the past 3 weeks).

Optimizing your time...

One student said they play the videos at 2X speed. I think that is a great idea. I tend to go over everything in significant detail, re-iterate previous things we learned, just to be safe. If you are solid on this stuff (REALLY SOLID ON IT), you can go through the lectures more quickly and slow down when you feel you need to.

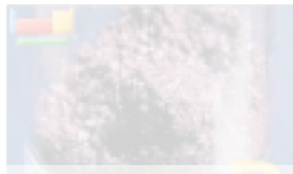
Folks also find it amusing as my voice sounds more like a mouse's w/ fast playback...

Videos Length

Every 2 years, I will redo the videos, make them into smaller bits, and generally improve them. For now they are good, my goal is to make them great!



EECS 2077 – Semiconductor Devices ©



Instructor – Prof. Jason Heikenfeld



Item or Week	2077 Semiconductor Devices
CLAS	1) Semiconductor bonding and doping. 2) Semiconductor band diagrams. 3) Drift vs. diffusion current.
8/23	Course Intro and Learning Incomes Quiz
8/25	1.1 Semiconductors and band diagrams (CH 1-3)
8/30	1.2 Generation/recombine & drift/diffusion (CH 4)
9/1	2.1 Diode contact potential (S 5.2)
9/6	2.2 Diode currents (S 5.3)
9/8	3.1 Metal-semic. / capacitance (S 5.7,5.5)
9/13	FALL READING DAYS – NO CLASS
9/15	3.2 Non-ideal diode & TEST REVIEW! (S 5.4)
9/20	Test #1
9/22	4.2 BJT Basics / Switching (S 7.1, 7.6)
9/27	NO CLASS
9/29	5.1 BJT Terminal Currents (S 7.4)
10/4	5.2 BJT Coupled Diode (S 7.5)
10/6	6.1 BJT Hybrid Pi (S 7.8)
10/11	Test #2
10/13	6.2 JFET / MESFET / HEMT
10/18	7.2 MOSFET ideal (S 6.4)
10/20	8.1 MOSFET real. (S 6.4)
10/27	8.2 MOSFET other applications / review / movie / tour
10/29	Test #3
11/1	10.1 Semicon. emission/absorption (S 4.2, 4.2)
11/3	10.2 Photovoltaics / photoreceivers (S 8.1)
11/8	11.1 LEDs / solid-state lighting (S 8.2)
11/10	11.2 Organic LEDs / FETs / photovoltaics
11/15	12.1 Lasers /silicon photonics (S 8.3, 8.4)
11/17	12.2 Imaging w/ CCD & CMOS (S 9.4) – Quiz and start Final Prep
11/22	Review Session For Final (open Q&A and practice problems)
11/24	Thanks Giving – NO CLASS
11/29	Final Week of Class: Exam Part 1
12/1	Final Week of Class: Exam Part 2
12/6	Exam Week – NO CLASS
12/8	Exam Week – NO CLASS

Schedule is online (**and may change!** So check the word version of the schedule, not the example I show at left).

Your homework to do before Thursday:

(1) go to the 'Syllabus/Schedule' folder on blackboard, see the syllabus, and this course intro power point. Read it again carefully. It describes the course policies and approach.

(2) view the online lectures (1A, and 1B). Lecture 1 is split into two mini lectures for your convenience.

(3) make sure you can answer the quiz questions at the end, that will prepare you for the quiz Thursday, and for doing the in-class work in small teams/groups.

We will do this for every class!

I cannot emphasize enough:

WORK HARD AND MAKE SURE YOU DEEPLY UNDERSTAND ALL TOPICS LEADING UP TO THE FIRST TEST. If you do so, the rest of the course is a breeze. If not, the course will be much more difficult!

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman^{a,1}, Sarah L. Eddy^a, Miles McDonough^a, Michelle K. Smith^b, Nnadozie Okoroafor^a, Hannah Jordt^a, and Mary Pat Wenderoth^a

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Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning ($n = 158$ studies) and

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (*SI Materials and Methods*),

Key points:

- (1) 6% increase in test scores in active learning sections vs. traditional lecture.
- (2) traditional lecture sections (passive learning) were 1.5 times more likely to fail the course

Its fun! It's not boring! <https://www.youtube.com/watch?v=ss2hULhXf04>

This mirrors quite closely the improvements I have seen in my own courses when switching from passive learning (traditional lecture) to active learning (flipped classroom) etc.

My goal: minimize myself – you take control of the learning and teaching each other!

Advantages?

- Students tend to view lectures the night before, or right before, class, and the problem session therefore re-enforces and solidifies lecture content before they forget it... (procrastination :)
- It is more difficult for students to fall behind... only 'no-shows' tend to be at risk of failing.
- Problems can be more real-world (messy-open ended), I can act as the 'customer'.
- Is a particularly superior method for re-enforcing conceptually difficult material.
- The final impetus for me to flip was to resolve the '8 AM class' issue... THIS RESOLVES IT!
- Soft-skills development (inter-group communication, articulate your solution to the customer!)
- Is like tutoring the entire class...
- Forces 'loaners' into the same thing as 'study groups'...
... breaks down cultural/gender barriers as well.

Disadvantages?

- Takes a lot of work to get it setup correctly! If not done correctly, will be worse for students.
- May not be ideal for all types of courses.
- The flipped format resolves challenges with the CONCEPTUALLY hard topics. But it is no replacement for repetition of key calculations, that must be preserved in the work!
- Some students prefer and may learn better in class-room with traditional interactive lecture (NOT a video). But they are the minority...

