

EE576: Integrated Memory Device and Technology

- Instructor: Prof. Eun Sok Kim (eskim@usc.edu, PHE 602, 740-4697)
 - Office Hours: Wednesdays and Fridays 3:00 – 3:50pm
- Class Time: Wednesdays 9:00 – 11:50am
- Textbook: Lecture notes from <http://blackboard.usc.edu/>
- EE 576 covers the fundamental principles of semiconductor memory devices and their applications:
 - NAND and NOR flash memory, SRAM, DRAM, resistive memory (memristor), phase change memory, magneto-memory, etc.
 - emerging trends in memory technology including multi-cells and 3D integration
 - advanced applications of memory or memory-like devices in emerging field of neuromorphic computing and in-memory computing
- Prerequisite: Understanding of basic semiconductor device physics and fabrication technology will be useful, but is not required.
- Supplementary Reference Books:
 - Nanoscale Semiconductor Memories: Technology and Applications, by S.K. Kurinec and K. Iniewski (editors), 2013, Available as an ebook from USC Library
 - NAND Flash Memory Technologies, by S. Aritome, 2015
 - Nonvolatile Memory Technologies with Emphasis on Flash, J. Brewer and M. Gill (editors), 2011

Course Contents and Grading

- Week 1: Introduction
- Weeks 2 & 3: MOSFET Basics
- Week 4: Floating Gate Device Operating Principles
- Week 5: Multi-level Cells of Flash Memory Devices
- Week 6: NAND And NOR Flash Memory Technology
- Weeks 7 & 8: Static RAM Cells and Operation Principles
- Weeks 9 & 10: Dynamic RAM Cells and Operation Principles
- Week 11: Resistive RAM Devices and Operation Principles
- Week 12: Phase Change Memory Device and Technology
- Week 13: 3D Memory Device Technology
- Week 14: Magneto-memory and Ferroelectric Memory
- ❖ No lecture on the five Wellness Days (F 3/12, Tu 3/23, **W 4/7**, Th 4/22, F 4/30)
- **Grading:** One Midterm Exam: 30%, Term Paper & Oral Presentation: 30%, Final Exam: 40%. Homework will be assigned, but not graded.
 - All exams are open books and notes.
- Midterm Exam: *Tentatively* March 10 (Wednesday)
- Final Exam: 8:00 – 10:00am on May 7 (Friday)

TERM PAPER

- Literature review on topic of your choice that is based on the course materials.
- DATES: March 31 (Wed.): Abstract due at the start of the lecture.
April 21 (Wed.): Term paper due at the start of the lecture.
April 28 (Wed.): Oral presentations.
- TERM PAPER FORMAT:
 - Cover page: Name, title of paper, and abstract which highlights the interesting results, significance and novelty of the paper, etc.
 - Text: Not more than 1,500 words of text expanding on the abstract/summary. Do a “word count” on the text, and show the number at the end of the text. List key references.
 - Figures: Unlimited number of figures with descriptive captions.
 - Appendices: Any number of pages of appendices may be attached, though not encouraged. Here, you may show long derivations of equations, extensive review of literature, (additional) examples and explanations.

Term Paper Grading

- GRADING: 60% on technical content and 40% on written and oral presentation
- The technical content includes
 - breadth (a minimum of seven quality papers) and depth of coverage
 - usefulness of the review
 - correctness of physics, mathematics, technical reasoning, etc.
- The presentation includes
 - clarity of oral presentation including slide preparation, mechanics.
 - effective classification/formatting and grammatical correctness of writing
 - effectiveness in showing the usefulness, significance, or accuracy of the results/review: effective use of figures, examples, etc.
- Plagiarism will be *severely* penalized!
 - The instructor knows it when he sees it.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>. Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The *Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. The *Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Diversity Statement

- The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. I encourage and support the efforts of all of our students to contribute freely and enthusiastically. We are members of an academic community where it is our shared responsibility to cultivate a climate where all students and individuals are valued and where both they and their ideas are treated with respect, regardless of their differences, visible or invisible.