Course Syllabus

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EEL 5934/4930 Modern Memory Device Technologies

(Spring 2018, MWF 4th period, BEN 328)

Big data applications drive growing needs of big memory. These applications will require lower latency to access your data, as well as cheaper and massive memories to store your data. It has presented a new challenge for the semiconductor industry. This course discusses how various modern memory device technologies work. The topics include discussions of various state-of-the-art volatile and nonvolatile memory device technologies and their limitations. To go beyond these limitations, the course explores emerging memory device technologies, including those that could be adopted by industry in the next decades in computers and mobile devices due to potential performance, density, power and cost advantages.

In addition, deep learning and neuromorphic computing algorithms do not run efficiently in state-of-the-art computer hardwares. Device technologies in future neuromorphic processors that mimic how human brain works, such as memristors, will be discussed. The realization of memristive functionalities is closely related to the emerging memory device technologies.

Prerequisite: The students are expected to have already completed an introductory level device course at the undergraduate level, such as EEE3396c here at UF or any equivalent course at other institutes.

Goals: (1) Explore state-of-the-art memory technologies

(2) Introduce emerging memory technologies for future big data applications

(3) Understand mechanisms and limitations of each memory device technology

(4) Introduce memristive devices for neuromorphic computing

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Office hours: the 3rd period, Wed.

Topics:

1. Brief introduction of field-effect transistors
2. State-of-the-art volatile memory devices: DRAM, SRAM
3. State-of-the-art nonvolatile memory devices: Flash memory technology
4. Spin transfer torque memory devices
5. Phase change memory devices
6. Resistive memory devices
7. Crossbar architecture
8. Device models of memristors
9. Other devices for neuromorphic computing
10. Course project and research paper presentation

Grading:

- 5% Homework: Late homework results in loss of points.
- 10% in-class quizzes and assignments
- 30% Exam: The exam is based on class notes including oral comments, problems solved in classroom and homework and quiz problems. The students are responsible for the above materials.
- 15% Midterm research paper presentation: Each student will choose a research paper, preferably related to their term project, in the field of memory device technology and present it in class. The presentations will be graded based on 1) the presenter's ability to clearly describe the problem, explain the solution, and evaluate the (experimental or simulation) results, 2) the quality of answers provided to the questions, and 3) the content of the slides.

- 40% Project: 35% final presentation, and 5% peer review participation. The schedules of the presentations will be available in the course e-learning website.

Half of the project presentation should be overview of the research field for the project, and the other half shall clear identify a problem, perform calculation, modeling, or simulation, and reach YOUR OWN conclusion on the memory device studied in the project.

Suggested project topics on memory device technologies include but are not limited to: CBRAM, ferroelectric memory, FTJ memory, MTJ memory, STT memory, Phase change memory, flash memory, SRAM, DRAM, artificial synapse and RRAM, artificial neurons, hardware for brain-like computing.

Attendance Requirements: As this course will have in class quizzes and assignments, consistent attendance is very important. Perfect class attendance is not required, but very consistent participation is expected. It will be tracked through participation in the in-class quizzes and assignments. There is no make-up for in-class quizzes and assignments.

Make-Up Exam Policy: If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed exam. University attendance policies can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

Honesty Policy: All students admitted to the University of Florida have signed a statement of academic honesty committing themselves to be honest in all academic work and understanding that failure to comply with this commitment will result in disciplinary action. This statement is a reminder to uphold your obligation as a UF student and to be honest in all work submitted and exams taken in this course and all others.

"...failure to comply with this commitment will result in disciplinary action compliant with the UF Student Honor Code Procedures (http://www.dso.ufl.edu/sccr/procedures/honorcode.php) "

Accommodation for Students with Disabilities: Students Requesting classroom accommodation must first register with the Dean of Students Office. That office will provide the student with documentation that he/she must provide to the course instructor when requesting accommodation.

UF Counseling Services: Resources are available on-campus for students having personal problems or lacking clear career and academic goals. The resources include:

- UF Counseling & Wellness Center, 3190 Radio Rd, 392-1575, psychological and psychiatric services.
- Career Resource Center, Reitz Union, 392-1601, career and job search services.

Software Use: All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Evaluation: Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at **https://evaluations.ufl.edu** **(https://evaluations.ufl.edu/)** . Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at **https://evaluations.ufl.edu/results/** **(https://evaluations.ufl.edu/results/)** .

Course Summary:

Date	Details