ECE 580: Storage System- Device to System Perspective

Class: STADM 1216
Lectures: Tu/Th 12:30-1:45 pm
Office Hours: Tu,Th 2-3pm
Course Credit: 3

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1. **Course Description & Objectives**
   This course will follow a bottom-up approach for modern storage system design, beginning with the foundational design concepts of storage elements such as memory cell, followed by an exploration of reliability issues within storage arrays, and concluding with the implementation of system-level countermeasures to address emerging security threats and reliability concerns.

   Upon the completion of this course, students will be able to:
   - Understand the design rules for a floating-gate memory cell.
   - Solve problems related to floating-gate cell design and their reliability.
   - Formulate algorithms to optimize design space trade-offs in storage systems.
   - Evaluate security vulnerabilities in a storage system.
   - Evaluate the effects of external conditions (such as temperature and radiation) on memory reliability.

2. **Prerequisites**
   ECE 202 Circuit Theory Applications (minimum grade of C)

3. **Textbook**
   “Inside Solid-State Drives (SSDs)", Second Edition. Editors: Rino Micheloni, Alessia Marelli, Kam Eshghi

4. **Webpage**
   This course will use CSU’s Canvas, and the ECE 580 course webpage in Canvas is only accessible to registered students. Lecture notes, assignments, solutions, grades, and general announcements will be posted or linked on the Canvas webpage.

5. **Course Topics**
   - Storage hierarchy and technological landscape
   - Evolution of storage technologies
   - Device physics of Flash memory cell
   - Cell reliability issues: Endurance, retention, and noise
   - Array structure: 2D and 3D NAND
   - Operation of NAND Flash memory array
   - Reliability and variability issues of NAND array
   - External operating condition: Temperature and radiation effects
   - Overview of Flash storage systems architecture
   - Reliability management: Error correction, wear-leveling

- Data sanitization issues and countermeasures
- Emerging security threats and countermeasures

6. **Grading:** Percentage for different assignments are given in the table below. The grade is determined according to the table at right below.

Assignments	Weights	Grading Scheme	
Homework	10%	90-100%	A
Midterm-1	15%	80-89.9%	B
Midterm-2	15%	70-79.9%	C
Project	30%	60-69.9%	D
Final Exam	30%	< 50%	F
Total	100%		

Homework: Homework assignments are posted online, and they are due at the beginning of the class on the day one week after the date of posting. All homework assignments should be submitted before the deadline via Canvas, and **late submissions will not be graded**!

Project: Project grade depends on the in-class presentation and project report.

Exams and Tests: The midterm exams will be held during class time for 70 minutes. It will be a closed book test, but students can bring one page formula sheet. Use of calculators is allowed in the exam. The final exam will be comprehensive.

7. **CSU Principles of Community**
   - Inclusion: We create and nurture inclusive environments and welcome, value and affirm all members of our community, including their various identities, skills, ideas, talents and contributions.
   - Integrity: We are accountable for our actions and will act ethically and honestly in all our interactions.
   - Respect: We honor the inherent dignity of all people within an environment where we are committed to freedom of expression, critical discourse, and the advancement of knowledge.
   - Service: We are responsible, individually, and collectively, to give of our time, talents, and resources to promote the well-being of each other and the development of our local, regional, and global communities.
   - Social Justice: We have the right to be treated and the responsibility to treat others with fairness and equity, the duty to challenge prejudice, and to uphold the laws, policies and procedures that promote justice in all respects.