EEE 498/591: Special Topics: Instrumentation for Extreme Environment Systems

Course description Analysis and design of instrumentation for extreme environment and space-based systems.

Objectives **T**o demonstrate how extreme environments affect electronic instrumentation and provide students with basic understanding of the how these harsh effects can be mitigated in systems.

Outcomes

1. Characterize radiation and temperature threats in the space and earth environments
2. Identify the impact of high and low temperature, and ionizing and non-ionizing radiation on electronic components
3. Analyze and model the impact of radiation and extreme temperatures on simple electronic instruments
4. Select technologies for extreme electronic operation based on performance and cost metrics
5. Implement basic radiation hardening practices

Course Topics

- Extreme Environments and Their Effects
  - Extreme Environments
  - Radiation Effects on Electronics
  - Temperature effects
- Instrumentation for Extreme Environment Systems
  - Basic Instruments
  - Analyzing and modeling EE on Instruments
- Mitigation Strategies
  - Robust material and device technologies
  - Packaging
  - Hardening-by Process
  - Hardening by Design

Textbook NSREC Archive of Short Course Notebooks, 1980-2006

Prerequisite EEE 202

Instructor Professor H. J. Barnaby.
Office hours GWC 316, Tuesday, Thursday 3:30-4:45
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Papers A midterm paper will be will be due after the eighth week of class. The paper should be in IEEE format length, no shorter than four pages, no longer then eight pages, and must contain at least 5 references from IEEE reviewed journal publications. Although suggested topics will be given when the paper is assigned, students are free to choose any topic that is appropriate. The general topic area would be any which deals with current issues related to extreme environments, systems and applications,

basic mechanisms of radiation/thermal effects, or radiation/thermal effects on devices and ICs.

Exams

There will be two closed-book, closed-notes examinations, in addition to a comprehensive final exam. Calculators and one 8 x 11 crib sheet will be allowed during the examinations. In -term examinations will be returned in class, and if not picked up within three weeks will be disposed of. Examination grading issues should be handled within three weeks of the examination return.

Final Design Project

Students will be required to submit a final report (~10 pages) detailing a design of a basic electronic device or instrument capable of maintaining functionality within targeted radiation and temperature specifications. The design may be developed with either circuit or process/device simulation programs, e.g. SPICE or SILVACO ATHENA/ATLAS.

Academic integrity

ASU policy on academic integrity can be found at www.asu.edu/studentslife/judicial/integrity.html

Grading

A, B, C, D, E grading system without plus/minus

Exam 1:	15%
Exam 2:	15%
Midterm paper:	15%
Design Project:	25%
Final:	30%

General rules

- Examinations, paper, and projects are to be completed by each student independently. It is acceptable to discuss work with a partner or two on papers and projects, but make sure to turn in your work. Be advised of the University's Code of Academic Integrity, which sets strict penalties.
- Late projects, papers and missed examinations will not be accepted unless proper documentation of illness or emergency is provided. Make-up exams are strongly discouraged but two dates will be made available at times and locations to be determined.
- Pay attention to the drop dates (not shown on the schedule above: check the university calendar); dropping is your responsibility.
- Please deal with homework/exam grading errors or issues promptly.

Syllabus (tentative)

Topics	**Sections**
1. Amplifiers	1.4-1.6
2. Diodes and diode circuits	3.1-3.5
3. MOSFET and analog MOS circuits	4.1-4.9
4. Current mirrors and active load circuits	6.3, 6.5
5. MOS digital circuits	4.10.1-4.10.4, 10.1-10.4

First midterm exam: Operational amplifiers and diodes
Second midterm exam: MOSFETs and analog MOSFET circuits
Final: Cumulative