ECE 544 Design of Electronic Packaging and Interconnect
A study of the design of digital and mixed signal interconnect and packaging. Topics covered include: single chip (surface mount and through-hole) and multichip module packaging technology, packaging technology selection, electrical performance of packaging, thermal design, electrical design of printed circuit boards, backplane and multichip module interconnect, receiver and driver selection, EMI control, CAD tools, and measurement issues. 3 credit hours.

Prerequisite An undergraduate-level course on the sophomore or junior level in RLC and in TTL and MOS transistor circuit analysis.

Course Objectives This class has been designed to equip students with the required knowledge and techniques so that they will be able to select amongst packaging and functional multi-chip partitioning alternatives so as to best meet the aim of the system and design systems to meet electrical delay, noise and other requirements, which includes determining technology details, selecting the appropriate active devices, placement and routing of the system.

A student will:

- Learn about packaging and interconnect options available, including printed circuit boards, single chip packaging, both surface mount and through-hole, and multichip modules
- Learn how to select amongst competing packaging options in order to meet system performance and cost requirements and goals
- Learn how the partitioning of a system amongst different chips and packages affects systems requirements and goals
- Learn about the fundamentals of digital circuit interconnect design, including characteristics of drivers for different logic families, impedance control, reflection noise, crosstalk noise, switching noise (ground bounce), and electromagnetic interference
- Learn how to design printed circuit board, backplane, and multichip module interconnect to achieve electrical delay and noise (signal integrity) aims
- Learn how to select (or design) drivers and receivers for different applications
- Learn about timing driven design
- Learn about the thermal design of packages
- Be exposed to industry Computer Aided Design tools that assist in this process.
Discuss modeling and other issues associated with these tools
Learn the principles of EMI control and discuss the associated rules
Be exposed to the considerations associates with design for testability and design for manufacturability, with emphasis on surface mount and multichip module technologies
Be exposed to electronic interconnect performance measurement techniques and standards.

**Course Topics**

- Review of Electronic Interconnect Measurement Standards and Techniques
- Overview of Packaging Technology Options
- Relevant characteristics of digital drivers-receivers
- Review of digital logic family characteristics
- Timing and Noise Budgeting
- Introduction to Transmission Line Theory
- Delay, attenuation, and ringing
- Crosstalk noise
- Simultaneous Switching Noise
- Power Delivery System Design
- EMI and EMC guidelines
- Thermal Design

**Textbook**


**Course Requirements**

- Homework: Two-week cycle (20%). Six problem sets total.
- Examinations: Two midterm (25%) and a final exam (30%).
  - All exams are open-book and open-notes.
  - Projects: None

**Software Requirements**

Access to H-SPICE circuit simulator, or equivalent, is required. You should ensure that you have a minimum of dial-in access to the NCSU eos system if you do not have H-Spice access at your remote location. Simple remote usage instructions will be given near the start of the course. Any alternate version should be approved by the instructor at the beginning of the course. The “student” version of P-Spice is NOT adequate for this course.
Computer and Internet Requirements

NCSU has recommended **minimum** specifications for computers used for classes. Depending on your computer needs, we recommend your computer meet or exceed the following minimum specifications below.

PCs must have an Intel-compatible 800 MHz processor, 256 MB RAM, 8 GB hard drive with 1 GB free space available, 256 Color Display, CD-ROM drive, 800x600 (min.) video adapter, sound card, and speakers. The operating system should be Windows 2000 or XP. Real One Player Basic (available free online) and high speed Internet connection such as cable, DSL, T1 or LAN will be required for EOL courses.

MAC users must have a G3 processor with firewire and USB factory built-in, 256 MB RAM, 10 GB with 1GB free space available, 256 Color Display, CD-ROM drive, 800x600 (min) video adapter, sound card, and speakers. The operating system must be MacOS 10.3 (minimum) along with the above RealOne and Internet specifications above.

For more detailed information on computer specifications and recommendations, please refer to our website at: http://engineeringonline.ncsu.edu/currentstudents/computeraccess.htm

Instructor

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