

**ECE711/ECE811 Digital Systems
Fall 2008**

Engineering Science: 50 %

Engineering Design: 50 %

2008 Course Description:

High-speed digital design principles and procedures including modular design techniques, printed circuit board technology, high-speed digital circuits and I/O standards, signal integrity principles and measurements, prototyping and documentation methods, and realistic considerations such as power distribution, noise reduction, crosstalk, trace impedance, loading, timing, termination, differential signaling, and design for manufacturing. A number of computer-aided design tools will be used to design and analyze digital systems. Laboratory, design, and homework exercises will be used to illustrate and reinforce the theory and concepts discussed in class. Prereq: ECE603/ECE668 or permission. Lab 4.0 cr.

Textbooks: *Handbook of Digital Techniques for High-Speed Design*, Tom Granberg, Prentice Hall PTR (Required Purchase, Durham Book Exchange)

High Speed Signal Propagation: Advanced Black Magic, by H. Johnson and M. Graham, Prentice Hall PTR (Reference Only)

References: Mentor Graphics on-line Documentation and Technical Documents
Assigned reading from other periodicals that will be placed on reserve

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Laboratory Coordinator: Dr. Richard Messner
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Pre-requisite: ECE603, ECE562 or Permission

Co-requisite: None

Prerequisites by Topic:

1. Principles of digital logic
2. Computer organization
3. Basic understanding of electromagnetic theory
4. Basic analog/digital circuit theory and electronics
5. Basic device structure and processing (BJT and CMOS)
6. Ability to use a personal computer, word processor, and graphics program

Course Web Site: www.ece.unh.edu/courses/ece711

Topics:

- Signal integrity;
- Modeling of PCB signals, termination schemes and device I/O circuits;
- Trace impedance and crosstalk;
- Ground bounce problems;
- High-speed I/O standards and IBIS modeling;
- Differential signaling and LVDS;
- Emitter coupled logic (ECL);
- Current mode logic (CML);
- PCB tools and design issues;
- Printed Circuit Board layout skills for high-speed systems;
- High-speed memory;
- Differential and mixed mode S-Parameters;
- Modeling with I/O buffer information specification (IBIS);
- EDA tools for design, simulation, verification, and layout;
- Technologies used for high-speed digital systems;
- Packaging and design for manufacturing;
- Digital system design principles;
- Microprocessor interfacing;
- Timing constraints, transmission line effects, and hazards.

Course Philosophy:

The purpose of this course is to introduce senior and beginning graduate students in electrical and computer engineering to system-level digital design technologies. There are four fundamentals determining this process: **technologies, design strategies, design tools, and implementation related limitations**. The course will address all these design aspects. The specific topics will include: PCB system tools, 2D EM field solvers, general design principles, prototyping procedures, specific digital considerations such as interfacing techniques, standards, high-speed circuit families, noise, loading, etc. **Much of the learning will occur independently using laboratory exercises.** Labs will be supported by formal classroom presentations and by assistance in the laboratory.

Tentative Course Lecture Schedule:

Weekly updates plus homework and design exercises will be posted at:

www.ece.unh.edu/courses/ece711.

Grading Policy:

	<u>Weight</u>
Design and Laboratory Exercises	30%
Homework and Quizzes	25%
Two Exams	30%
Final Comprehensive Exam	15%
Total	100%

Late Assignment Policy:

Assignments are always accepted after the stated due date. However, a late penalty of five (5) points per day will be applied to the assignment grade. Weekends are not counted in the calculation of the late penalty points.

Assignment Format:

All assignments should be typed (word processed); graphs, tables, and figures should be constructed with graphics or spreadsheet type programs. Be sure to number and annotate all graphics, tables, and figures with descriptive titles and reference them in the text portion of the assignment.

Disability Statement:

If you are a student with a documented disability who will require accommodations in this course, please register with Disability Services for Students in the Memorial Union Building, Room 118 (862-2607) for assistance in developing a plan to address your academic needs.

Office Hours:

Instructor office hours will be posted on his/her office door, announced in class, and placed on the main course webpage. Students having difficulty should seek help from the course instructor. If you would like to make an appointment with the instructor you should talk (or email) to him/her directly to arrange a mutually agreeable time to meet.

Policy for Plagiarism, Copying Assignments, or Cheating on Exams or Quizzes:

Each student should submit his or her own original assignments. The course instructor reserves the right to assign failing grades to assignments when students collaborate on assignments. Students caught cheating on exams or quizzes will receive a failing grade for the exam or quiz.

Responsibilities:

It is the student's responsibility to come to class prepared for that day's discussion. This includes reading the assigned text prior to lectures and completing all assigned homework primarily by your own individual efforts

and problem-solving skills. You should also accept the responsibility for providing constructive and timely feedback to the instructor so that your learning experience can be enriched to the fullest.

The instructor accepts the responsibility for clearly defining the material to be covered during this course and for facilitating your learning processes. Examples and homework will be closely related to the assigned reading and lectures; quiz and examination problems will test not only basic factual knowledge, but also your ability to associate and utilize factual material and problem-solving techniques in a new context. This is the essence of engineering!

Course Objectives:

- i. Introduce students to all aspects of the analysis and design of high-speed digital circuits and systems.
- ii. Introduce students to computer-aided analysis and design tools for digital system design within the Mentor Graphics CAD suite, which includes PCB Libraries, DxDesigner, Librarian, Expedition PCB and Hyperlynx.
- iii. Expose students to printed circuit board technology, signal integrity issues, IBIS modeling and S-Parameters.
- iv. Introduce high-speed I/O standards and memory configurations.

Relationship of Course Objectives to Program Outcomes:

The matrix below shows how course objectives support the EE and CE program outcomes. The following scale is used:

0 = no support; 1 = weak support; 2 = moderate support; 3 = strong support

Program Outcomes	Course Objectives			
	i. (High-Speed/System Design)	ii. (CAD Tools)	iii. (PCB and Signal Integrity)	iv. (I/O Standards and Memory)
An ability to apply knowledge of mathematics, science, and engineering	3	3	3	3
An ability to design and conduct experiments, as well as to analyze and interpret data	3	3	3	3
An ability to design a system, component, or process to meet desired needs	3	3	3	3
An ability to function on multi-disciplinary teams	0	0	0	0
An ability to identify, formulate, and solve engineering problems	3	3	3	3
An ability to communicate	2	0	0	0

effectively				
An understanding of professional and ethical responsibility	1	0	0	0
The broad education necessary to understand the impact of engineering solutions in a global and societal context	3	3	3	3
A recognition of the need for, and ability to engage in life-long learning	3	3	3	3
A knowledge of contemporary issues	3	3	3	2
An ability to use techniques, skills, and modern engineering tools necessary for engineering practice	3	3	3	3