University of California, Santa Cruz
Computer Engineering Department
EE-173 & 173L, Spring 2015

High-Speed Digital Design

Lecture Room: Soc Sci 2 167 (MWF 11am – 12:10pm)
Laboratory Room: JBE 115
Instructor: S.C. Petersen (petersen@soe.ucsc.edu)
Office: JBE 251 (x9-4782)

Course Description:

This course discusses the design and construction of digital circuits meant to operate at high speeds on printed circuit boards. Unlike low-speed digital circuits, where we can largely neglect the effects of passive circuit elements, high-speed design requires that special attention be paid to them. Our vocabulary must now include large-signal behavior of analog devices, a unified understanding of the alternate perspectives between the time and frequency domains, and application of field and waves to clearly understand transmission lines and radiation.

Hence, our general perspective will aim at practical applications built on solid theoretical foundations. Thus, we will survey topics from linear systems, device theory (active and passive) and the relationship between circuit and wave theory. A solid foundation of the terminal behavior of high-frequency analog circuits implemented as logic families will be discussed. Field theory will be presented at a level suitable to clearly understand how to interconnect active and passive components using transmission lines and understand the phenomenon of radiation. Essentially, we will examine both the theoretical concepts and practical techniques to gain some experimental expertise, including an appreciation of measurement limitations.

Students are expected to possess a working knowledge of basic electrical engineering network analysis (EE101), including an introduction to op-amps, diodes and bipolar junction transistors (EE-171 recommended). With the background from EE174, we will be able to more fully develop advanced topics in high-speed PCB design, especially multi-layer boards and simulation.

A related topic, designing for manufacture, will include electromagnetic compatibility (EMC) and electromagnetic interference (EMI).

References:

Required: Johnson and Graham, High-Speed Digital Design, A Handbook of Black Magic, PTR 1993
Optional and recommended: Tom Granberg, Handbook of Digital Techniques for High-Speed Design, PTR 2004
Lecture notes (handed out in class)
Supplementary references will be discussed in lecture and posted to our website.

Homework:

Homework will be assigned and collected during class sessions, and will generally follow a weekly sequence; solutions will be handed out (or posted to our web site) on the date of collection. Material will consist of problems from our text, supplementary and extra-credit problems. To receive full credit, your work must be well organized, readable and show evidence of thoughtful attention to the problem itself. *Sloppy, difficult to follow submissions will not be considered for grading*. Letter grades will be assigned for all homework as described following:

A: complete and thoughtful solution; numerical correctness is *not* the sole criterion, conceptual correctness is.
B: thoughtful solution displaying clear evidence of attention to problem but some conceptual errors present.
C: numerically correct result(s) without evidence of conceptual understanding or thoughtful solution.
… to each of the above, **+** or **-** as appropriate…
D: numerically incorrect result(s) without evidence of conceptual understanding or thoughtful solution.
NC:no credit.

Homework in this class is important. Take it seriously and resolve to spend time on it well ahead of the due date. Evidence of copying between students will result in an NC for that assignment for all students involved – regardless of who actually "worked" the problem(s). Note that I do not object to students studying together; I do object to plagiarism. Indicate on your homework any students you collaborated with and explain the degree of their contribution to your work.

Examinations: There will be two exams and a comprehensive final exam.

Evaluation: Letter grades will be assigned for all work. Averaging will follow the usual 4.0 point scale to determine a final grade point and associated letter grade.

Homework	30%	
Two Exams	20% each.	
Final	30%	comprehensive exam; passing this test is required to pass the class.

Citizenship in the laboratory:
Unlimited and unsupervised use of laboratory equipment (computers, printers etc.) and resources (web-access, email, ftp etc.) is a *privilege* not a right. Any abuse of equipment or misuse of resources will result in the immediate loss of these privileges, and may result in disciplinary action by the University. Note too that all food and beverages are expressly prohibited in lab, and the door should never be left propped open. We enjoy competent and professional support from the Baskin Engineering Lab Support Group (bels@soe.ucsc.edu). Immediately report any problems pertaining to the laboratory to them; they can also be consulted for parts you may need.

Academic Integrity:
The student-instructor relationship is based on imputed trust. Violations of this trust by deceptively offering the work of others as your own, cheating on examinations etc. will result in formal charges of academic dishonesty being brought against you.