EE 311 Microelectronic Devices & Circuits II (Required)

Course description:
311 Electronic Devices and Circuits II (3) (Sp)
Differential and multistage amplifiers with bipolar junction transistors(BJT) and field-effect transistors (FET). Biasing in integrated circuits and active loads. Frequency response of common-emitter (common-source), common-base (common-gate), common-collector (common-dran) single BJT (FET) stages. Frequency response of differential-pair, cascode, and multistage circuits. Selection of coupling and by bypass capacitors. Analog integrated circuits. Metal-Oxide-Semiconductor (MOS) digital circuits with emphasis on CMOS. LEC/LAB

Prerequisite(s) & Corequisite(s):
EE 310 Electronic Devices and Circuits I & (Corequisite) EE 353 Electronic Circuits Lab

Textbook(s):
"Microelectronic Circuits", 4th ed., Sedra & Smith, Oxford University Press
ISBN 0-19-511633-1
"Notes for EE 311; Electronic Devices & Circuits II", James J. Whalen, 2002

Course objectives:
(1) To understand the operation of the basic building blocks in differential amplifier circuits and their assembly into a multistage amplifier that might be used for the multistage amplifier design required in EE 353 Electronic Circuits Lab.
(2) To be able to analyze & design for (EE 353) BJT & MOSFET multistage amplifiers using expressions for single-stage amplifiers derived in EE 310 and to determine frequency response.
(3) To understand MOS digital circuits including the CMOS inverter, CMOS logic gates, dynamic logic gates, and flip-flops.

Topics covered:
(1) The operation of BJT, MOS, & BiCMOS differential amplifiers circuits including the basic BJT & MOS differential amplifier stages, biasing with current mirrors (basic, Wilson, & Widlar), active loads and a multistage amplifier using these components. The use of PSPICE to demonstrate the performance of differential amplifiers circuits including differential gain, common-mode gain, input resistance, and output resistance.
(2) The frequency response of single-stage amplifiers studied in EE 310 and of multi-stage amplifiers including the cascode, Darlington, differential amplifier, and two & four stage cascades. The use of short-circuit time constants to determine coupling and bypass capacitor values and open-circuit time constants to estimate upper half-power frequency. The use of PSPICE to demonstrate the performance of single & multi-stage amplifiers including voltage gain, input & output resistances, and lower & upper half-power frequencies.
(3) The operation of MOS digital circuits with the design & performance of the CMOS inverter, CMOS logic gates, dynamic logic gates, & latches and flip-flops. Use of PSPICE to demonstrate the performance of the CMOS inverter, CMOS logic gates, and dynamic logic gates.

Lecture/laboratory schedule:
There were three 50-minute lectures and one two-hour computer lab/recitation each week.
Weeks 1 to 5: Chapter 6 Differential Amplifiers (14 Lectures & 4 Labs & Exam)
Weeks 6 to 9: Chapter 7 Frequency Response (12 Lectures & 3 Labs & Exam)

Weeks 10 to 14: Chapter 13 MOS Digital Circuits (14 Lectures & 4 Labs & Exam)
Week 15: Final Exam
Grading was based upon the average of the PSPICE lab average and the exam average.

Professional significance:

Students analyze single-stage and multistage circuits, simulate the circuits using PSPICE, and demonstrate and explain the circuit performance. These skills are needed for the design of multistage circuits including a multistage amplifier in EE 353 Electronic Circuits Lab and for the design of CMOS analog IC's in EE 459 Analog Integrated Circuit Layout. See Criterion 4(b).

Relationship of Course to Program Outcomes:

(a)	2	Students demonstrate and explain simulated electronic circuit results to TA's in 10 labs.
(b)	1	Students do PSPICE simulations of basic building blocks and demonstrate results.
(c)	2	This is done for a multistage amplifier design in the co-requisite lab EE 353
(d)	0	
(e)	1	This is done for a multistage amplifier design in the co-requisite lab EE 353
(f)	1	Students are required to demonstrate that their work is their own in labs.
(g)	1	Students must demonstrate and explain results to TA's in 10 labs.
(h)	0	
(i)	1	Students must recognize that they have been only introduced to electronic circuits.
(j)	0	
(k)	2	Students analyze and simulate and demonstrate PSPICE simulations to TA's in 10 labs.
(ee1)	0	
(ee2)	2	Students demonstrate skills with electronic circuit analyses in 3 exams and final
(ee3)	0	
(ee4)	1	

Prepared by:
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