CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ETE 446

COURSE OUTLINE

Course Information	**ABET Unit Classification** (4 Quarter Units)
Department: Engineering Technology Course Number: ETE 446/446L Course Title: Switching Circuits and Devices/Lab Revision Date: 12/14/04 Revised by: Lyle B. McCurdy Compliant: Catalog 2004/05	Math: Basic Science: Engineering Topics: 4 *Contains significant design content:* Yes Other: Curriculum Designation: Tech Elective

I. Catalog Description

ETE 446/446L Switching Circuits and Devices/Lab (3/1)

Analysis of circuits operating in a switched mode. Waveshaping, timing, and logic families. Special devices. A-D and D-A converters. 3 lectures/problem solving and 1 three-hour laboratory. Prerequisites: ETE 305, 310.

II. Prerequisites and Corequisites

Student are expected to have a working knowledge of network analysis, including transients in RC and RL circuits, and a working knowledge of BJT and FET devices including biasing and small-signal models including the effects of interelectrode capacitance.

III. Textbook and/or other Required Material

Jaeger, R.C., Microelectronic Circuit Design, 1997, McGraw Hill, or equivalent.

Keown, John, OrCAD PSpice and Circuit Analysis, Prentice Hall, 4th Edition or equivalent.

IV. Course Objectives

Upon successful completion of this course, each student will be able to:

1. Analyze/design switched-mode BJT circuits including "overdrive" and capacitive and inductive loads.
2. Analyze/design discrete and/or linear IC multivibrator circuits, including bistable, monostable, astable and schmitt trigger circuits, including the use of integrated-circuit timer devices such as the NE555 or equivalent.
3. Analyze/design voltage and current sweep circuits using discrete and/or linear IC devices.
4. Analyze/design interface circuits for connections between different logic families such as TTL and CMOS.
5. Analyze/design circuits utilizing digital-to-analog and analog-to-digital converters.
6. Use Pspice in lecture and lab to simulate circuits above. And to work in teams to equate theoretical, experimental, and simulation data and write formal laboratory reports that meet professional writing standards.

V. Expanded Course Description

1. **BJT switches** (1 week)
   Overdrive and load lines; current, voltage, and timing effects of C and L loads, w/Pspice simulations.
2. **BJT interelectrode effects on rise time** (1 week)
   Using the hybrid-pi model to predict delay, rise, storage, and fall times of BJT/MOS devices, w/Pspice simulations.
3. **Linear voltage and current sweep circuits** (2 weeks)
   Analysis/design of linear voltage and current sweep circuits, wPspice simulations.
4. **Multivibrator circuits** (2 weeks)
   Analysis/design of discrete/IC bistable, monostable, astable MVs; schmitt triggers, w/Pspice simulations.
5. **Logic families and interfacing** (2 weeks)
   Internal characteristics of TTL and MOS gates; interfacing circuits, w/Pspice simulations.
6. **Digital-to-analog and analog-to-digital converters** (2 weeks)
   Internal characteristics and applications of DAC and ADC devices, w/Pspice simulations.

VI. Class/Laboratory Schedule

Lecture: Two 75 minute sessions per week.
Lab: One 3 hour session per week.

VII. Contribution of Course to Professional Component

Lecture: Students learn to analyze, design, and to develop an understanding of the characteristics and limitations of operational amplifier circuits.

Lab: In lab, students learn to analyze, design, set up test apparatus, test, and record pertinent data associated with typical op-amp circuits. They also learn to assimilate and document comparisons of theoretical, experimental, and Pspice-simulated results into formal laboratory reports written to professional standards as specified by the laboratory instructor.

VIII. Evaluation of Students

The instructor evaluates outcomes using the following methods: homework assignment submittals, midterm and final exams, one-on-one discussions during office hours, laboratory experiments, and laboratory reports.

The student grades are typically based on the following factors: quizzes, homework, midterm exam and final Exam.

IX. Relationship of Course Objectives to Program Outcomes

Crse Obj	Program Outcomes										
	(a) **Use of modern tools of discipl**	***(b)*** **Use of math, science, Engg & Tech**	***(c)*** **Do experi -ments**	***(d)*** **Dsn of sys & compo nents**	***(e)*** **Work on teams**	***(f)*** **Do Tech probs**	***(g)*** **Eff Com**	***(h)*** **Life-long learn**	***(i)*** **Prof, ethics, social resps**	***(j)*** **Prof, soc, globl, diversity**	***(k)*** **Qual, Cont impr, timeli ness**
1		X		X		X					
2		X		X		X					
3		X		X		X					
4	X					X					
5	X	X	X	X	X	X	X				

X. Typical Laboratory Experiments. Here, the students are expected work with BJT and MOS circuits operating in a switched mode with practical laboratory applications. Circuit simulations using Pspice is required. The following labs are oriented to achieve this purpose:

Lab 1. Current, voltage, and time response of a basic BJT common-emitter switch.
Lab 2. Current, voltage, and time response of a BJT common-emitter switch with capacitive/inductive loads.
Lab 3. Interelectrode effects upon delay time, rise time, storage time, and fall time of BJT CE switches.
Lab 4. Analysis and design of a schmitt trigger circuit.
Lab 5. Analysis and design of astable and/or monostable multivibrator circuits; use of NE555 or equivalent.
Lab 6. Analysis and design of interface circuitry for TTL to CMOS devices.