

- Session: Class: M 6 – 8:30 in J-215A Lab: M 8:40 – 11 in Q-335
- Text: P. Gray, P. Hurst, S. Lewis, R. Meyer, *Analysis and Design of Analog Integrated Circuits*, 5ed, New York, John Wiley and Sons, 2009.
The 4th edition (2001) can be used but some differences exist.
- References: R. Kielkowski, *Inside SPICE: Overcoming the Obstacles of Circuit Simulation*, New York, McGraw-Hill, 1994.
J. Connelly and P. Choi, *Macromodeling with SPICE*, Englewood Cliffs, NJ, Prentice-Hall, 1992.
G. Massobrio and P. Antognetti, *Semiconductor Device Modeling With SPICE*, 2ed, New York, McGraw-Hill, 1993
OrCAD PSpice A/D Reference Manual, ver. 9, Beaverton, OR, OrCAD, Inc., 1998.
OrCAD PSpice A/D User's Guide, ver. 9, Beaverton, OR, OrCAD, Inc., 1998.
- Prerequisite: Background equivalent to ECET 2300, ECET 2310
- Instructor: Walter Thain
Office: Q-142 (678) 915-7436
ECET Department Phone: (678) 915-7246
Home Phone (before 9 PM): (770) 579-3051
Office Hours: posted at my office, on Vista, or by appointment
e-mail: wthain@spsu.edu
web: See the 6001 Vista course site and my ECET web site
(<http://fac-web.spsu.edu/ecet/wthain/>)
- Objectives: The student will gain an understanding of the SPICE circuit simulator, including the analysis types available as well as its internal operation. Emphasis is placed on developing and verifying simple and complex device and circuit models through simulation and measurement. Device-level, macromodel, and behavioral circuit modeling techniques are examined. Methods to improve simulation convergence, accuracy, and speed are discussed. Upon successful completion of the course, the student will be able to:
- Describe the techniques used by SPICE to solve circuit equations for linear and nonlinear analysis
 - Optimize simulator performance by controlling simulator operating parameters
 - Demonstrate how to modify the linear and nonlinear models used for semiconductor devices such as diodes and transistors to match component data sheet specifications
 - Describe the difference between behavioral modeling, macromodeling, and device level modeling
 - Demonstrate the use of macromodeling techniques for circuit simulation
 - Describe the technique used by SPICE for timestep control during time-domain simulations

- Demonstrate analog circuit design techniques

Attendance: On-time attendance is expected. You are responsible for everything covered and all assignments given during classes you miss. Obtain assignments, handouts, etc., for days you miss from classmates, from the Vista site, or ask me after class. Lab attendance is discussed in the Laboratory Policy section of the syllabus.

Homework: Homework will be assigned and may be collected for grading. Homework is for your benefit, so do not fall behind. If you are having trouble, see me or consult with classmates.

Homework turned in for grading may be neatly handwritten unless specified otherwise.

Quizzes: There will be three tests over material covered in class and lab. If you miss a test with an approved absence, you must make it up as soon as possible after your return.

Unapproved absences result in a zero for the test grade. If you must miss a quiz, obtain approval at least **48 hours** in advance of the test. Extenuating circumstances, e.g. a car accident, will be given consideration.

Quiz Dates:

Quiz 1: Monday, February 13

Quiz 2: Monday, March 26

Quiz 3: Monday, April 23

Laboratory: Each student must perform **all** hands-on lab exercises to pass the laboratory portion of the course. **Department policy requires the student to pass the laboratory portion of the course (earn 60% or better) in order to pass the course**

Lab exercises may or may not require a lab report or a lab quiz. Those that do not are called check-off labs.

Lab exercises requiring a report or a lab quiz count the same. Check-off labs count as 1/3 of a report/quiz lab.

The lab grade is computed as follows:

$$\text{Lab Grade} = \frac{\sum \text{Report/Quiz Grades} + 33 \times \sum \text{Check Lab Grades}}{(\text{Number of Report/Quiz Labs} \times 100) + (33 \times \text{Number of Check Labs})} \times 100$$

All lab reports are informal and use a memo format. **All work must be computer generated.** An exception is for hand written calculations and results included in an appendix.

Unless specified differently, lab reports are due on the next day your lab section meets within the first 10 minutes of the lab session. After that, the report is late 1 day. Each working day late costs 10 points off. A weekend counts as one day.

Lab reports must be turned in electronically. See the General section of this

policy document for electronic document submission specifications. Failure to follow the electronic submission specifications can result in a points taken off for that lab exercise. Note that you can turn in paper copies of an appendix to keep electronic file sizes down. Do not turn in the laboratory exercise instructions as part of your lab report.

Read the lab exercise before arriving at the lab session. **Be sure to complete any required prelab assignment before coming to the lab session. It is part of your grade for that lab and it will be collected or checked at the beginning of the session.**

On-time attendance is expected. If you miss a hands-on lab with an approved absence, you can make it up at a mutually agreed upon time and you can earn full credit for the lab exercise.

If you miss a hands-on lab with an unapproved absence, including check-off labs, you must make up the lab; but your grade for the lab portion of the course reduces by 12 points. If the hands-on lab missed with unexcused absence normally required a lab report, you do not have to turn one in because it will not be graded. Once you make up the lab exercise, the penalty is implemented by giving you full credit for the particular exercise and subtracting 12 points from the overall lab grade.

If you miss a Demo lab with an unapproved absence, you cannot make up the lab and your grade for the lab portion of the course is reduced by 12 points. The penalty is implemented by giving you full credit for the particular exercise and subtracting 12 points from the overall lab grade.

Failure to make up a missed hands-on lab exercise before the last day of class results in a 0 for the lab portion of the course grade; and therefore you fail the course.

If a required report for a hands-on lab is not turned in, you receive the minimum credit specified by the instructor for having performed that lab correctly.

Failure to take a lab quiz reduces that individual lab's grade by the number of points the quiz is worth.

Failure to turn in a homework-type lab exercise report results in a 0 for that individual grade only.

Final Exam: The final exam day and time will be given later in the semester.

Grading:	Quiz Avg.	$60\% - (2\% \times \text{Number of Homework assignments})$
	Final Exam	20%
	Homework	2% each, (there may be double homework assignments)
	Lab	20%

A = 100-90, B = 89-80, C = 79-70, F = below 70

General:

See the **Course Info – Start Here** module on the VISTA page for logistical information, including a copy of the syllabus and details on using VISTA.

Electronic document submissions must be in ONE Microsoft Word format (.doc or .docx) file and submitted via the VISTA course e-mail (not SPSU e-mail) or the VISTA course Assignments tool.

Late homework is penalized 10 points per 24-hour period, starting immediately after the class period in which it is due. For lab reports, the late period begins 10 minutes after the beginning of the lab session during which the report is due.

Late work must be turned in to (a) me in person, or (b) the ECET secretary's office, or (c) the technician lab if after 5 pm. Your deliverable will be dated signed by the person receiving it. **You may also submit late lab reports via VISTA e-mail (not SPSU e-mail).**

Neatness on work turned in for grading is important. Work that is sloppy or contains spelling and grammatical errors will be penalized.

If you appeal a grade, I reserve the right to re-grade the entire test or assignment. **All appeals for re-evaluation of a grade must be made within 5 working days after the assignment was returned to the class. Appeals can be made by e-mail.**

Students are responsible for following the Student Conduct Code given in the Undergraduate catalog, particularly those paragraphs dealing with academic dishonesty.

Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the counselor working with disabilities at the ATTIC as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

ECET 6001 Course Outline

Week	Topic	Reading
1/9	Introduction, SPICE overview, (see Note 1 below)	K: Ch. 1 G: Appendix A.1.1, 2.9, Appendix A.2.1
1/16	Holiday	
1/23	Understanding simulation, numerical integration, convergence	K: Ch. 2, 3, 4
1/30	Convergence, timestep control	K: Ch. 3, 4, 5
2/6	Diode model, ideal diode	Notes
2/13	BJT model, QUIZ 1	G: 1.3.1-1.3.3
2/20	BJT model	G: 1.3.1-1.3.3, 1.4
2/27	MOSFET model	G: 1.5-1.6
3/5	Spring Break	G: 3.5.1-3.5.6
3/12	MOSFET model, differential amplifier	
3/19	Differential amplifier, current mirrors, active loads	G: 4.2, 4.3
3/26	Output stages, QUIZ 2	G: 5.4-5.5
4/2	Op Amps	6.3, 6.8, Notes
4/9	Op Amps, compensation	9.1-9.4, 9.6
4/16	Compensation	Notes
4/23	Macromodeling and behavioral modeling, QUIZ 3	Notes
4/30	Macromodeling and behavioral modeling	Notes

Note 1: "K" refers to the Kielkowski book and "G" refers to the Gray, et.al. book

ECET 6001 Lab Schedule

Lab Date	Topic		Report Due Date
1/16	Holiday		
1/23	LTSpice Tutorial	Demo	Not graded
1/30	RLC Filter	Hands-on	Check-off
2/6	LC Oscillator Model	Hands-on	1 Week
2/13	Diode Transfer Curve	Hands-on	Check-off
2/20	BJT & Class B Buffer	Hands-on	Check-off
2/27	MOSFET & CMOS Inverter	Hands-on	1 Week
3/5	Spring Break		
3/12	Diff Amps	Hands-on	1 Week
3/19	Current Mirrors	Hands-on	Check-off
3/26	Multi-Stage Amp (Part 1)	Hands-on	2 Weeks after Part 2
4/2	Multi-Stage Amp (Part 2)	Hands-on	(counts as 2 labs)
4/9	Op Amp Macromodel	Hands-on	1 Week
4/16	Gilbert Multiplier	Hands-on	Check-off

Note: this schedule, lab topics, and grading requirements are subject to change.

ECET 6001 Memo

To: Dr. Walter Thain

From:

Partners: Put your partners' name here if applicable

Group Report? Yes or No. Indicate whether you are submitting this report as a group (if permitted) or individual

Subject: This is the title of the lab exercise

Date: Report date

Introduction:

The first section of your report should be a *brief* summary of what was done and why it was done. To do this, you should read the entire laboratory instruction sheet, including the procedure section. Do not repeat the step-by-step instructions; instead give an overview of the procedure.

Results:

This section documents the results of the exercise and validates the analysis and conclusion sections of your report. Make use of tables when appropriate to organize your presentation of results. Include the results of prelab exercises in this section. Use equation numbers, table numbers, and figure numbers. For example, Eq. 1, Table 1, and Fig. 1 are typical naming conventions when referencing these items in a report. Be sure to include a title for figures and tables. Note that equation numbers are justified on the right margin and are given numbers like (1), (2), etc. Look at how it is done in your text. Note that figure titles appear under the figure and table titles are above the table.

Questions:

This section is reserved for answering the questions included at the end of the laboratory instructions if present. **Copy the complete question from the lab instructions and follow it with the answer.**

Conclusions:

This section pulls together all the information in the report and advises the reader of the important results. Do not recite the procedure. **All lab reports must have a good conclusion.**

Appendices:

Include equation derivations and hand calculations here. Some figures and graphs may be contained here. When your report text references equations and figures in an appendix, be sure to use proper equation and figure numbers.

Note: Make your report concise and well organized. It is important that you use proper grammar and spelling. Always use complete sentences. Paragraphs consist of at least 3 sentences. Use the

same type font throughout the report. Write your report in the third person so that it reads like a newspaper story. That is, do not use I, we, us, etc. Use either Times, Arial, or Courier fonts. Use 10 pt or 12 pt size only and do not change from one to the other. Use 8.5 inch × 11 inch paper.