

ECE 718 Computer Aided Circuit Analysis, Spring 2017.

Textiles, Room 2116. Fridays 12:50pm to 3:35pm.

INSTRUCTORS:

Prof. Rhett Davis, 442 MRC	Prof. Michael Steer, 435 MRC
919-515-5857 rhett_davis@ncsu.edu	919) 515-5191 mbs@ncsu.edu

PREREQUISITES:

Graduate standing in Electrical and Computer Engineering (this is an advanced graduate class – exploratory type). You must have a background in circuits such as having taken ECE511, ECE549, ECE546 or ECE733. Currently ECE511 is listed as the prerequisite. If you do not have ECE511 contact Dr. Steer, mbs@ncsu.edu and he will guide you.

TEXTBOOK:

None. Notes will be provided.

COURSE OBJECTIVES:

Computer aided tools are used in modeling and simulating circuits and systems with the aim of representing a circuit fully so that it works the first time it is fabricated. The purpose of this course is to introduce students to circuit analysis topics with emphasis on their computer implementation. Students will learn how Spice and harmonic balance circuit simulators work, how shooting (periodic steady-state) simulation works, how event-driven simulation works, how to develop compact models (the approach used in circuit simulators), and how to develop models of circuits and transistors using Verilog-A.

COURSE DESCRIPTION:

The course will examine the simulation of circuits and systems. This course necessarily dives deep into the fundamentals of circuit theory. All the theory behind the first circuits class you took as an undergraduate. We dive deep into the theory behind circuit simulation including what can be modeled and what cannot be modeled. Why simulation does not always work and why simulation cannot model everything about circuits. A broad spectrum of analysis techniques are considered including linear, time-domain, harmonic balance, event driven, and simulation of sampled data systems. The theory behind Verilog-A will be explored and Verilog-A will be used to describe compact modeling. You will finish this class with knowledge that will enable you to be the person in a design group who is the resident expert in circuit simulation and in using Verilog-A.

COURSE REQUIREMENTS:

Homework: Ten homework sets (10%)

Examinations: Two quizzes (25% each). The second quiz will be held at the time of the scheduled final exam.

Computer Software: Programming skills required. Skills in modeling using Verilog-A will be learnt.

Computer Facilities: University facilities are sufficient.

Project: The project is oriented towards gaining detailed knowledge of how devices, circuits and systems are modeled. This illustrates both the compromises imposed by our simulation technology and how detailed circuit knowledge is used to enable complex circuits, such as mixed-signal circuits, to be modeled. The project will be extensive and involve implementing a model using Verilog-A. Students will work individually on the project. The project will be worth 40%.

COURSE OUTLINE:

The course will be taught as three modules that will overlap slightly in time to enable problems to be resolved in setting up the project environment.

MODULE 1: Fundamentals of Circuit Simulation (or “How Spice works”)

Topics: Device and circuit modeling; Analysis of linear circuits; Transient (Spice) analysis of circuits. Compact modeling.

MODULE 2: Compact modeling: (compact modeling is the modeling used in circuit simulators) Modeling and Simulation in Verilog-A. Project: modeling using Verilog-A.

MODULE 3: Advanced Circuit Simulation Topics:

Multi-Physics and Multi-Scale Modeling using Compact Models

Understanding signals in analog, RF, microwave and mixed signal circuits

Steady-state analysis of nonlinear analog circuits, Event-driven simulation.

STUDENTS WITH DISABILITIES

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653. http://www.ncsu.edu/provost/offices/affirm_action/dss/ For more information on NC State's policy on working with students with disabilities, please see http://www.ncsu.edu/provost/hat/current/appendix/appen_k.html

ACADEMIC INTEGRITY

All the provisions of the [code of academic integrity](#) apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid.