ELEC5508 / ELG6358

Advanced Methods for Circuit Simulation

This course is intended for developers/users of CAD tools and circuit/system designers. The objective is to provide in-depth understanding of the fundamental basis of circuit theory as well as advanced simulation techniques. The applications of the covered topics span a wide spectrum of engineering fields.

Course Outline

State-Space Equations:

- Concept of states
- Time-invariant and time-variant circuits
- Dynamical equations
- State-transition matrix
- Periodic circuits

Circuit Properties:

- Frequency, time, and Laplace-domains
- BIBO and Asymptotic stability
- Lyapunov equations
- Multiport networks
- Passivity
- Causality
- Nonlinearity

Frequency-Domain Simulation:

- Modified-Nodal Analysis
- LU decomposition
- Sparse techniques

Time-Domain Simulation:

- Laplace and Fourier transforms
- Multi-step methods
- Numerical stability
- Complex analysis
- Cauchy Theorem
- Numerical Inversion of Laplace transform

Simulation of Nonlinear Circuits:

- DC Analysis
- Jacobian matrix
- Newton's iterations
- Iterative time-stepping solution

Overview of Model-Order Reduction (MOR)

REFERENCES

(1) Computer Methods for Circuit Analysis & Design
J. Vlach and K. Singhal, Van Nostrand Reinhold 1983/ 1994
(2) Electronic Circuit and Simulation Methods
L. Pillage, R. Rohrer, C. Visweswariah, McGraw-Hill 1995
(3) Circuit Simulation
F. Najm, Wiley, 2010.
(4) Linear and Nonlinear Circuits
L. Chua, C. Desoer, McGraw-Hill, 1987
(5) Linear System Theory
W. Rught, Prentice Hall, 1996

+ **Handouts**

Background Prerequisite

Math, Circuit Theory and Design, Numerical techniques, and Linear Algebra.

Course Grading

50% Final Exam *(open book)*
50% Midterm Exams and Assignments

Passing the final exam is necessary condition for passing the course

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