

COMPUTER-AIDED ANALYSIS OF ELECTRONIC CIRCUITS

Exam topics

1. Introduction

- 1.1. *Simulation techniques: principles and advantages (optional)*
- 1.2. *Examples of analysis types based on computer-aided simulation (optional)*
- 1.3. Circuit simulation flow. General structure of a simulation program

2. Circuit models of electronic devices and components

- 2.1. Basic set of the elements used in the circuit modeling
- 2.2. Hierarchy and types of circuit models
- 2.3. Principles for development of circuit models
- 2.4. Circuit model of junction diodes
- 2.5. Circuit model of bipolar transistors

3. Electrical networks topology: the key to computer formulation of the Kirchhoff laws

- 3.1. Basic concepts in electrical network topology
- 3.2. Topological matrices: incidence matrix
- 3.3. Topological matrices: loops matrix
- 3.4. Topological matrices: cutset matrix
- 3.5. Fundamental relationships among branch variables
- 3.6. Computer-based generation of the topological matrices A, B, and D.

4. Nodal linear network analysis

- 4.2. Computer formulation of nodal equations for linear networks: nodal analysis, modified nodal analysis, tableau method
- 4.3. Algorithms for solving of linear algebraic equation systems:
 - Gaussian elimination,
 - LU factorization
 - Pivoting techniques; Rounding errors
- 4.4. Sparse matrix techniques for circuit analysis:
 - Effect of ordering of equations,
 - Determination of Fills in LU factorization,
 - The near-optimum ordering algorithm,
 - *The data structure for sparse matrices (optional)*

5. Nodal non-linear resistive network analysis

- 5.2. Topological formulation of nodal equations
- 5.3. Fixed-point iteration concept
- 5.4. Newton-Raphson algorithm
 - Newton-Raphson algorithm for one equation in one unknown
 - *Rate of convergence (optional)*
 - Newton-Raphson algorithm for solving systems of nonlinear equations
- 5.5. Solving the nodal equations by the Newton-Raphson algorithm and its associated discrete equivalent circuit
- 5.6. The convergence criteria of the Newton-Raphson algorithm. Convergence options in SPICE.
- 5.7. Modified Newton-Raphson techniques.
 - Algorithms for limitation of variable values between iterations
 - Algorithm for rises in steps of the sources.