Day 1: Governing equations, automated generation of systems of equations

- Lecture 1: Example problems, governing equations
- Lecture 2: Matrix formulation of equations for linear problems, node-branch (sparse tableau formalism)
- Lecture 3: Formulation of equations for nonlinear problems & linearization, nodal formulation

HW: - Simple Circuit Simulator: Static (DC) Analysis for Linear Circuits (Nodal Analysis Formulation)
- Static Thermal Analysis (1D Heat Equation) by using the above simulator

Day 2: Numerical solution of linear algebraic equations

- Lecture 4: Gaussian elimination, floating point number representation & arithmetic
- Lecture 5: Numerical conditioning, ill-conditioned problems
- Lecture 6: Computations with sparse & structured matrices

HW: - Page Ranking in Search Engines (Power iteration, sparse matrices, structured matrices, factored representations)
- Conditioning of Simple Polynomial Interpolation (Ill conditioned problems)

Day 3: Numerical solution of nonlinear algebraic equations

- Lecture 7: Fixed point iteration & Newton's method in one dimension
- Lecture 8: Newton's method for system of coupled nonlinear algebraic equations
- Lecture 9: Improving convergence of Newton's method

HW: - Newton's Method in 1D and Simple Continuation (i.e., Source Stepping)
- Multi-Dimensional Newton's Method: Static (DC) Analysis of Beam-Joint Mechanical Structures

Day 4: Numerical solution of ordinary differential equations

- Lecture 10: Forward & backward Euler, trapezoidal rule
- Lecture 11: Multistep methods, accuracy & stability
- Lecture 12: Implicit vs explicit techniques, region of stability, stiff problems

HW: - Simple Circuit Simulator (continued from Day 1): Transient Thermal Analysis (Linear ODE nodal formulation, fixed time-step FE, BE, trapezoidal)
- Transient Analysis of a Nonlinear Dynamical System: Van der Pol Oscillator (Nonlinear ODEs, fixed time-step FE, BE, trapezoidal)

Day 5:

Lecture 13: Modelling and Analysis of Non-stationary Low Frequency Noise in Electronic Circuit Simulation