Engineering Faculty Document No. 11-07
May 16, 2007

TO: The Faculty of the College of Engineering
FROM: The Faculty of the School of Electrical and Computer Engineering
RE: ECE 54600 Changes in Description, Terms Offered, and Requisites

The faculty of the School of Electrical and Computer Engineering has approved the following changes in ECE 54600. This action is now submitted to the Engineering Faculty with a recommendation for approval.

From: **ECE 546 Digital Computational Techniques for Electronic Circuits**
Sem. 2. Class 3, cr. 3. Offered every third semester.
Prerequisites: Masters Student Standing or higher; or Prerequisite: ECE 255, 301.
Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

Description:
Digital computer methods for dc, ac, and transient analyses of electronic circuits. Linear, nonlinear, and piecewise linear dynamic circuits are considered. Actual usage of programs ECAP, SPICE, CORNAP, SNAP, and MECA in coursework. Algorithms used in these programs are studied.

To: **ECE 54600 Digital Computational Techniques for Electronic Circuits**
Sem. 2. Class 3, cr. 3
Prerequisites: ECE 25500 and ECE 30100, or graduate standing

Description:
Digital computer methods for dc, ac, and transient analyses of electrical and electronic circuits. Linear, nonlinear, and piecewise linear dynamic circuits are considered. Algorithms used in circuit/system simulators such as SPICE, Saber, EMTP, Simulink, and ACSL are studied.

Reason: The course description has been changed to reflect the updated content of the course. The requisites have been revised in form to be consistent with other ECE courses. The terms offered have been changed to reflect the actual offering schedule. Will be offered in even numbered years.

M. J. T. Smith, Head
School of Electrical and Computer Engineering

ECE 546 Digital Computational Techniques for Electronic Circuits

Required Text: Lawrence Pillage, *Electronic Circuit & System Simulation Methods*, McGraw Hill, 1995; ISBN 0-07-050169-6.

Recommended References:
Chua and Lin, *Computer Aided Analusis of Electronic Circuits: Algorithms and Computational Technques*, Prentice Hall, 1975; ISBN 0-13-165415-2.
Vlach and Singhal, *Computer Methods for Circuit Analysis and Design*, Van Nostrand Reinhold, 1994; ISBN 0-442-01194-6.
M. Crow, *Computational Methods for Electric Power Systems*, CRC Press, 2003: ISBN 0-8493-1352-X.
Assorted Papers

Lectures	***Principal Topics***
1	Overview of circuit simulation programs.
5	DC and AC analysis of linear networks. Explicit form of nodal equations. Gaussian elimination and LU factorization.
3	DC analysis of nonlinear resistive networks. Fixed-point and Newton-Raphson algorithms. Companion model.
5	Implicit integration. Discretized circuit models for capacitors and inductors. Transient analysis.
3	Circuit models for semiconductor devices (diodes, BJT, FET). Macromodel for op amps.
5	Computer formulation of Kirchoff's laws, fundamental loop, and cutset matrices.
5	Formulation of state space models.
5	Sparse matrix techniques. Fill-ins and ordering algorithms. Packed vector implementation.
6	Numerical integration methods. Stability region of numerical integration algorithms.
3	Computational complexity of nodal and state-model-based solvers.
3	Co-simulation methods.

Course Outcomes: A student who successfully fulfills the course requirements will have demonstrated:

i) knowledge of fundamental algorithms used in circuit and system simulators [1,2,3;a,e].

ii) an ability to select appropriate algorithm/parameters for specific circuits/systems [1,3;a,e].

iii) an ability to formulate and implement complex circuit/system models [1,4;a,e].

iv) an understanding of stability/convergence properties of numerical integration algorithms [1,2;a,e].

v) knowledge of cosimlation methods [1,3;a,e].