EEE3422 Adv Computer Applications in EE
Fall 2002

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2001 – 2003 Catalog Data: Prerequisites: MCS3413, EEE3123, Corequisite: EEE3313. Computation techniques for electrical engineering, including matrix methods and solution of differential and integral equations. Application of specialized programs for solving engineering problems. Use of computer simulation techniques. Lect 1 hr., Lab 2hrs. 2 hours credit

Textbook: Advanced Computer Applications in Electrical Engineering, R. Johnston LTU

Coordinator: R. Johnston

Goals: This course seeks to expose junior level Electrical Engineering students to numerical solutions of problems similar to (but more sophisticated than) the problems that they have been solving by hand in the core EE courses (including differential equations). The numerical solutions are produced using packaged applications (Maple, Mathcad, and Matlab) rather than by direct programming in FORTRAN or C. The course also exposes students to a Computer Algebra System (Maple) for obtaining exact solutions to systems of algebraic equations.

Prerequisites by topic
:
Physics 2 Semesters Mathematics 5 Semesters Circuits 2 Semesters Electronics 1 Sem

Topics

Resistor and diode models, ideal diodes, Shockley diode equation, diode load lines, intro to Mathcad, intro to Matlb, Intro to Maple, roots of equations, Newton's algorithm, roots of systems of linear and non-linear equations. (1 Lec, 2 Lab)

The common emitter amplifier, source splitting, thevenin's equivalent, DC hybrid pi model of BJT, AC hybrid pi model of BJT, bias stability constraint, maximum swing constraint, definition of hie, tradition approximate design, Av and Rin by node voltage analysis in Maple, formulation and algebraic solution of the 5 design equations in 5 unknowns via Maple. Numerical solution of design equations formulated in Maple via Mathcad. Spice, spice on the vax, spice analysis of design solutions found in Maple and Mathcad. (3 Lecs, 3 Labs)

Limitations of the hybrid pi model of the BJT, 4 quadrants of BJT operation, Ebbers-Moll static and dynamic models, numerical coefficients in Ebbers-Moll models, Gummel-Poon static and dynamic models, model reduction for design purposes, development of design equations using reduced Gummel-Poon models, numerical solution of the 9 design equations in 9 unknowns via Mathcad. Symbolic manipulation in Mathcad. (2 Lecs, 2 Labs)

Magnetic phenomena, lines of force, permeability, magnetic materials, magnetic load-lines. Curve fitting, interpolating polynomials, least squares fit polynomials, numerical solution of the magnetic load-line problem. Symmetric reluctances, region of applicability of curves that are fit to data, multi-path magnetic flux problem, reading dimensioned drawings. Systems of equations, the Jacobian matrix, extension of Newton,s algorithm to systems of equations. Cubic splines, cubic end-point fit, quadratic end-point fit, linear end-point fit. (3 Lecs, 3 Labs)

Electric utility power flow problem, one line diagrams, nodes, busses, transmission line model, AC power, P, Q, Watts, Vars, power factor, fundamental power formula, per-unit system. Bus types, bus numbering, node voltage analysis, the power flow equations. Line data table, calculation of Y buss and theta. Bus data Newton's algorithm, intrinsic and extrinsic variables, Newton's method without inverting the Jacobian. Norms, calculation of the Jacobian, solution of both the intrinsic and the extrinsic power flow equations. (4 Lecs, 3 Labs)

Numerical integration in Mathcad, numerical integration by the trapezoidal rule, derivation of Simpson's rule via Maple, quad and quad8 in Matlab, vectorization, numerical differentiation. Numerical solutions of ODEs, Euler's method, ode23 and ode34 in Matlab. Principle of operation of induction motors, Steinmetz model, torque, slip, Thevenin again, development of torque-slip curve in Matlab, solution of motor DE at start-up in Matlab. (2 Lec, 1 Lab)

Exam 1 Lab

Outcome	**Support**	**Rationale**
1	+++	Virtually every problem that is presented to the students increases their ability to apply their knowledge of math, science, and engineering to the solution of engineering problems. The projects give them experience in handling large, complicated mathematical models
2	+	The curve fitting exercises give the students an opportunity to analyze and interpret data.
3	++	There are explicit design exercises.
4	+	The students are encouraged to work in teams in the labs.
5	++	Students are exposed to a wide variety of engineering problems in this course.
6	-	
7	+++	Each assignment and exam turned in by the student increases the student's ability to communicate technical information in writing, and many of the assignments require the communication of information graphically. This is a writing intensive course requiring a formal engineering report for several of the projects.
8	-	
9	+	As we must continuously update the course materials as versions of the software changes, the students are reminded of the need to keep current in their field.
10	++	Many examples of contemporary computational issues are discussed in the context of the solutions of various problems.
11	+++	The extensive use of modern software in this course prepares students for engineering practice in the 21st century.
12	-	

Key to ratings:

+++ strong emphasis ++ emphasis + minor emphasis- no emphasis

Prepared by: R. Johnston Date: July 25 2001

Grading:

Students are expected to attend ALL sessions; the instructor does not bring material to class more than once. This includes handouts and graded material being returned to students. If you miss a session, you may pick up material at the instructor's office.

Assignment 1	5%	31 Jan 02
Project 1	10%	14Feb 01
Project 2	7.5%	28 Feb 01
Midterm	20%	7 Mar 01
Assignment 2	5%	28 Mar 01
Project 3	7.5%	4 Apr 01
Assignment 3	5%	11 Apr 01
Assignment 4 & 5	5%	18 Apr 01
Project 4	10%	2 May 01
Assignment 6	5%	At Final Exam
Final Exam	20%	

> 93	A	73 - 76	C
90 - 92	A-	70 - 72	C-
87 - 89	B+	67 - 69	D+
83 - 86	B	63 - 66	D
80 - 82	B-	60 - 62	D-
77 - 79	C+	< 60	F

There is a 10% per week penalty for work turned in late.

Project reports must stand alone: someone who has never seen the course packet should be able to follow what you did and what your results mean. Project reports must be word processed (including schematics and equations), and all computer output must be clearly labeled, e.g. "Maple Calculation of Common Base Amplifier Resistances," and all computer output must be liberally commented.