Resources for a Modern Differential Equations Course

Henry J. Ricardo
Department of Mathematics
Medgar Evers College (CUNY)
1150 Carroll Street
Brooklyn, NY 11225
(718) 270-6118
herme@cunyvm.cuny.edu

After teaching calculus for several semesters using the CCH materials, I felt it was time to consider teaching a modern, reform differential equations course. I attended conferences and workshops. I read the journals and examined every recent textbook I could find. I learned about the power and limitations of graphing calculators and various software products. Finally I developed the picture of the kind of course I would try to teach.

To me, a “modern” differential equations course is one that develops a lean and lively group of topics from a dynamical systems perspective and uses technology to treat these topics graphically, numerically, and analytically. Such a course acknowledges that many (most?) differential equations cannot be solved in closed form and uses qualitative and numerical methods to analyze solutions. With emphasis on a student’s ability to analyze problems orally and in writing, such a differential equations course is a natural successor to a reform calculus sequence.

What follows is a (partially annotated) list of resources that I hope will help others devise their own modern differential equations course. These resources are grouped into four categories: books, journal articles, software, and Internet sites. I welcome comments and additions.

BOOKS:

Differential Equations with Mathematica - M. Abell and J. Braselton

Differential Equations with Maple - M. Abell and J. Braselton


Differential Equations with Derive - D. C. Arney
(MathWare, Urbana, IL: 1993) ISBN 0-9623629-3-X

An Introduction to Differential Equations and Their Applications - S. Farlow


Calculus (Chapter 9) - D. Hughes-Hallett, A. Gleason, et al.

Differential and Difference Equations Through Computer Experiments (Second Ed.) - H. Koçak [+ Phaser software and lab manual]

Introductory Differential Equations: From Linearity to Chaos (Preliminary Ed.) - E. Kostelich and D. Armbruster


Using MATLAB for Differential Equations - J. Polking


Maple ODE Lab Book - D. Redfern and E. Chandler [+ Diskette]

Differential Equations: An Introduction with Mathematica - C. Ross
[+ Instructor’s Manual and Answer Book, on-line electronic supplement]

Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering - S. Strogatz
ARTICLES:

Any issue of C•ODE•E -- newsletter published quarterly and available gratis from C•ODE•E, Math. Dept., Harvey Mudd College, Claremont, CA 91711 (See reference in INTERNET SITES.)

Special Issue on Differential Equations - The College Mathematics Journal (Vol. 25, No. 5, November 1994)


“A Project Component for a Differential Equations Course,” M. McDonald, Primus IV (No. 3, Sept. 1994), 219-228


“Using a Computer Algebra System to Enhance a Traditional Undergraduate Course in Ordinary Differential Equations,” A. P. Ferzola, Primus IV (No. 4, December 1994), 383-395


“Pendulum Motion - The Value of Multiple Solution Methods,” W. Barker, Primus III (No. 3, Sept. 1993), 225-244

“PHASER-Based Courseware for Ordinary Differential Equations,” L. Zia, Primus I (No. 1, March 1991), 49-64
SOFTWARE:

See the *College Mathematics Journal* Special Issue on Differential Equations, pp. 458-461, for brief reviews of a dozen ODE solvers. Issues of the C•ODE•E newsletter (see ARTICLES) sometimes contain reviews of software. ODE Architect has been developed with NSF support by C•ODE•E and is available through John Wiley & Sons and Intellipro, Inc. Page xi of Zill’s book (mentioned above) has a list of nineteen programs and their publishers/distributors. Also, Interactive Differential Equations (IDE), a CD-ROM with workbook by B. West, S. Strogatz, J. McDill, and J. Cantwell, will be published in July, 1996 by Addison-Wesley Interactive. (See the first item under INTERNET SITES for further information.)

INTERNET SITES:

http://awi.aw.com/products.html#mathematics
Addison-Wesley Interactive page advertising Interactive Differential Equations (IDE). (See reference under SOFTWARE heading.)

http://brillig.nebrwesleyan.edu/~glarose/delabs/
Bill McClung, Gavin LaRose, and Dick Vogt at Nebraska Wesleyan U....Course material (including 9 Mathematica labs), 3 projects, and the Spring 1996 syllabus; plain TeX and PostScript files; physical configuration of computer lab

http://cross.sewanee.edu
Clay Ross at The U. of the South...on-line supplements to his DE book (see above)...Mathematica notebooks...DOS and Mac formats

http://math.bu.edu/odes/
Boston U. Differential Equations Project...information about the Blanchard/Devaney/Hall text (see above)...Instructor’s Manual, errata...workshop information...sample syllabus; articles on teaching differential equations

http://math.bu.edu/INDIVIDUAL/bob/
Bob Devaney’s home page at Boston U....other ODE information and syllabi for various dynamical systems courses taught (or planned to be taught) at BU

Eric R. Kaufmann at U. of North Carolina at Wilmington...Differential Equations Lab Manual...classroom examples (theory and applications)...PostScript and Maple V files...traditional approach, but with technology

http://www.ma.iup.edu/MathDept/Projects/CalcDEMma/Summary.html
Indiana University of Pennsylvania...description of computerized learning environment...Mathematica notebooks for calculus and differential equations
http://www.math.arizona.edu/Software/azmath.html
U. of Arizona...extensive software for calculus, ode’s, and other topics, including “Are You Ready for Ordinary Differential Equations?” and other diagnostic programs

http://www.math.hmc.edu/codee/home.html
Home page (at Harvey Mudd College) for C • ODE • E (Consortium for Ordinary Differential Equations Experiments)...on-line issues of the newsletter, reviews of DE solvers, graphics

http://www.math.rpi.edu/~boycw/index.html
William Boyce’s home page at Rensselaer Polytechnic Institute...course information, including assignments and class handouts...excellent Maple worksheets

http://www.math.scarolina.edu/~meade/math242
Doug Meade, U. of South Carolina...course notes, syllabus, exams, projects, homework assignments (and solutions)...Maple worksheets; guest lectures; material from other universities

http://www.math.unl.edu/
Glenn Ledder, U. of Nebraska (Lincoln)...DE course materials...Maple and Mathematica files; other math course materials

http://www.uidaho.edu/~calvert/
Jim Calvert at the U. of Idaho (Moscow)...course information, Maple worksheets...traditional, but with technology

http://www.wam.umd.edu/~stuck/schol/scholhome.html
The SCHOL Project at the U. of Maryland (College Park)--using mathematics software to enhance undergraduate education...samples from the texts Differential Equations with Maple [Mathematica] (see above), PostScript images of M/M solutions

http://zelda.thomson.com/rcenters/diffeq/diffeq.html
Differential Equations Resource Center (PWS Publishing Co.)...discussion threads, exercises, problems, lab projects, applications...software...on-line courses and course notes...information on workshops, symposia, conferences...labs at Rose-Hulman Inst. of Tech., Nebraska Wesleyan, et al....labs to accompany Differential Equations with Boundary Value Problems (Third Ed.) by Zill and Cullen; the Electronic J. of Differential Equations; Mathematics Archives (U. of Tennessee)