UNIVERSITY AT BUFFALO DEPARTMENT OF MATHEMATICS
STATE UNIVERSITY OF NEW YORK UNDERGRADUATE STUDIES

MTH 306 ORDINARY DIFFERENTIAL EQUATIONS (4.0)

TEXTBOOK: Blanchard, Devaney, and Hall, Ordinary Differential Equations, 2nd ed. (Brooks/Cole).
Web-accessible guidance for use of Maple in this course: http://www.math.buffalo.edu/306/index.html and http://emerald.math.buffalo.edu/~ringland/306/ .

SYLLABUS: Chapters 1-6 should be covered. Discussion of Power Series Solutions to be inserted between Ch 5 and Ch 6.

REMARKS: This course offers a balance of analytical, qualitative (graphical and descriptive), and numerical techniques, making extensive use of Maple (the computer algebra and graphics package). The computer lab Hochstetter 139 will be reserved for your recitations, to be used as extensively as desired. Note that only MTH141 and MTH142 are prerequisites for this course: it cannot be assumed that all students have knowledge of vectors or multi-variable calculus.

CHAPTER TOPIC

1 FIRST ORDER EQUATIONS Omit 1.9.
(3 weeks) Modeling via differential equations. Analytical, qualitative and numerical techniques: an example of each. Existence/uniqueness. Equilibria and the phase line. Parameterized families of differential equations: bifurcations. Linear differential equations (integrating factor technique).
REMARK: It is an empirical fact that students have difficulty with the concept of the phase plane: it is for this reason that more attention than you might initially feel warranted is given to the "phase line" in Ch 1.

2 FIRST ORDER SYSTEMS
(2 weeks) The predator-prey model. The phase plane. Vector fields and direction fields. Second order equations and the harmonic oscillator. Euler's method for systems.

3 LINEAR SYSTEMS
(3 weeks) Caution: MTH241 is *not* a prerequisite: you cannot assume knowledge of vectors.
Linearity. Straight-line solutions. Phase planes for linear systems with real eigenvalues. Complex eigenvalues. Repeated and zero eigenvalues. One-parameter families of linear systems: bifurcation.

4 FORCING AND RESONANCE Omit 4.5.
(1 week) Forced harmonic oscillator: method of undetermined coefficients. Sinusoidal forcing and resonance.

5 NONLINEAR SYSTEMS Do 5.3 and 5.4 lightly. Omit 5.5 and 5.6.
(2 weeks) Caution: In choosing what to teach from this chapter, be aware of the obligation not to rely on students' knowledge of underlying material from MTH 241.
Equilibrium point analysis, linearization. Nullclines. Systems with a conserved quantity: solution curves as level curves. Systems with a decreasing quantity: impossibility of closed loops. Recommended not to do Hamiltonian systems *per se*, but this does not prevent you from using the undamped nonlinear pendulum as an example of a system with a conserved quantity.

X POLYNOMIAL APPROXIMATION AND POWER SERIES SOLUTIONS
(1.5 weeks) Text has no coverage of this: use a source of your choice.
College of Engineering requests coverage of series solution about a regular singular point.

6 LAPLACE TRANSFORMS Omit 6.5 and 6.6.
(1 week) The Laplace transform. 1st and 2nd order equations with discontinuous and impulsive forcing.