UNIVERSITY AT BUFFALO
STATE UNIVERSITY OF NEW YORK

NOTE: This document is published only as an indication of what is typically taught in this course. Instructors have the responsibility of deciding on topics to be omitted, additional topics to be included, and the emphasis, ordering, and pacing of presentation of topics.

DEPARTMENT OF MATHEMATICS
UNDERGRADUATE STUDIES
244 MATHEMATICS BUILDING
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SAMPLE SYLLABUS

Course Number: **MTH 306**

Course Title: **Ordinary Differential Equations**

Credit Hours: **4.0**

Textbooks: **UB Custom package**, composed of chapters 1-6 of **Blanchard, Devaney, and Hall, *Ordinary Differential Equations*, 3rd ed**, a chapter on ***Power Series Solutions and the Method of Frobenius*** by **B. Hassard**, and a supplement ***Linear Algebra for Calculus*** by **Heuvers et al.**

Description: **Analytic solutions, qualitative behavior of solutions to differential equations. First-order and higher order ordinary differential equations, including nonlinear equations. Analytic, geometric, and numerical perspectives will be covered, as well as an interplay between methods and model problems. Necessary matrix theory will be discussed, and differential equation models of phenomena from various disciplines will be explored. Integrated into the course is the use of a mathematical software system designed to aid in the numerical and qualitative study of solutions, and to aid in the geometric interpretation of solutions.**

Prerequisite: **MTH 142 College Calculus II.**

Syllabus: Chapters 1-6 of Blanchard et al. and Hassard's "Ch X" should be covered. Use of the supplement on Linear Algebra is left to the discretion of the instructor: feedback to the Undergraduate Studies office on this invited. This is a very full syllabus: do not fall behind in the beginning!

NOTE: 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). Note that only Calculus 1 and 2 (MTH 141 and 142) are prerequisites for this course: it cannot be assumed that all students have knowledge of multivariable calculus.

USE OF MAPLE: MTH 306 is approved for satisfying the "**Computer Applications" requirement** in the Math Major. It is therefore expected that students receive substantial exposure to Maple in the course. Maple resources for the instructor are maintained at **www.math.buffalo.edu/306/**. Additional advice and support in the use of Maple in this course is available on request from the Undergraduate Director.

# Weeks	***Chapter***	***Topic***	***Comment***
3 weeks	1	**First Order Equations** - Modeling via differential equations. Analytical, qualitative & numerical techniques: an example of each. Existence/uniqueness. Equilibria & the phase line. Parameterized families of differential equations: bifurcations. Linear differential equations. Integrating factors.	
2.5 weeks	2	**First Order Systems** - The predator-prey model. The phase plane. Second order equations and the harmonic oscillator. Euler's method for systems.	*Omit Section 2.5*
3 weeks	3 + LA suppl.	**Linear Systems** - 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.	
1 week	4	**Forcing and Resonance -** Forced harmonic oscillator: method of undetermined coefficients. Sinusoidal forcing and resonance.	
1.5 weeks	5	**Nonlinear Systems** - 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.*	*Sections 5.3 & 5.4 lightly* *Omit sections 5.5 & 5.6* ***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 (Calculus 3)
1.5 weeks	Hassard X	**Polynomial Approximation and Power Series Solutions** Engineering requests coverage of series solution about a regular singular point.	
1 week	6	**Laplace Transforms** - The Laplace transform. 1st and 2nd order equations with discontinuous and impulsive forcing.	*Omit sections 6.5 and 6.6*