University at Buffalo
The State University of New York
Department of Mathematics
Office of Undergraduate Studies
233 Mathematics Building
E-mail: math-undergrad@buffalo.edu
Ph: (716) 645-8785

SAMPLE SYLLABUS
This document is published as an indication of the core content of the course. Instructors have responsibility of deciding on additional topics to be included, and the emphasis, ordering, and pacing of presentation.

Course Number: **MTH 306**

Course Title: **Introduction to Differential Equations**

Credit Hours: **4**

Textbook: **J. Lebl, et. al.** ***Notes on Differential Equations, UB edition 2***. This is an Open Source textbook. The UB edition contains Lebl's original text and some additions made by Hassard, Javor, Ringland, and Viraj. Students can get a PDF for free from the department or the web. They can order a print copy from Amazon. Be sure to get the UB edition.

Prerequisites: MTH 141-142

Notes: MTH 241 is not a prerequisite for this course: it cannot be assumed that all students have knowledge of multivariable calculus. This course is approved for satisfying the "Computer Applications" requirement in the Math Major. It is therefore expected that students receive substantial exposure to computing.

This schedule is written for 13 weeks of instruction. A typical semester has 14 teaching weeks. Thus, some flexibility is built in.

Week	Sections	Topics
1	0.1- 0.3, 1.1, 1.2	Introduction to ODEs, Classification of ODEs, Integrals as solutions, Slope fields
2	1.3 – 1.6	Separable equations, Linear equations and the integrating factor, Substitution, Autonomous equations
3	1.7, 1.8, 2.1	Numerical methods: Euler's method, Exact equations, Second order linear ODEs
4	2.2 – 2.4	MIDTERM EXAM I Constant coefficient second order linear ODEs, Higher order linear ODEs, Mechanical vibrations
5	2.5, 2.6, 3.1	Nonhomogeneous equations, Forced oscillations and resonance, Introduction to systems of ODEs
6	3.2 – 3.4	Matrices and linear systems, Linear systems of ODEs, Eigenvalue method
7	3.5, 3.6	Two dimensional systems and their vector fields, Second order systems and applications
8	3.7, 3.8	Multiple eigenvalues, Matrix exponentials
9	3.9, 8.1	MIDTERM EXAM II Nonhomogeneous systems, Linearization, critical points, and equilibria
10	8.2 – 8.4	Stability and classification of isolated critical points, Applications of nonlinear systems, Limit cycles
11	8.5, 7.1, 7.2	Chaos, Power series, Series solutions of linear second order ODEs
12	7.3, 6.1, 6.2	Singular points and the method of Frobenius, The Laplace transform, Transforms of derivatives and ODEs
13	6.3, 6.4	Convolution, Dirac delta and impulse response

Student Learning Outcomes for
MTH 306 Introduction to Differential Equations

Assessment measures: weekly homework assignments, 2 midterm exams, final exam.

At the end of this course a student will be able to:	**Assessment**
– understand the concept of existence and uniqueness of solutions of a DE – understand the concept of a general solution, a particular solution and initial conditions – draw slope fields by hand and also by computer	HW1, Midterm I Final Exam
solve 1st order DEs (both nonlinear and linear) using various techniques: integrating factor, separable DE, substitution method, exact DE	HW2, Midterm I Final Exam
– understand the equilibrium solutions – draw the phase diagram – perform the stability analysis: identify stable points, unstable points, saddle points, and bifurcation points	HW3, Midterm I Final Exam
– solve 2nd order constant coefficient homogeneous DEs – understand the concept of linear independence and determine if functions are linearly independent using Wronskian. – understand that linear combinations of two linearly independent solutions give the general solution	HW4, Midterm I Final Exam
– solve non-homogeneous 2nd order DEs – use the method of undetermined coefficients to find the particular solution	HW5, Midterm II Final Exam
– understand the "resonance" and "beat" phenomena – understand what the system of equations is – solve DEs using the method of elimination (convert two DEs into one and vice versa).	HW6, Midterm II Final Exam
understand the basic notions of linear algebra such as vector, matrix, determinant, and eigenvalue	HW7, Midterm II Final Exam
– rewrite the system of DEs in the matrix form – compute eigenvectors and eigenvalues for the derived matrix – solve the system of equation using the eigenvalues in three different cases: real distinct roots, repeated roots, and complex roots	HW8, Midterm II Final Exam
– sketch the direction fields and indicate stability on the phase plane – perform the stability analysis of a linear system using eigenvalues – draw slope fields and solution curves using a computer.	HW9, Final Exam
– predict behavior of solutions of some nonlinear system using analysis of eigenvalues – set up a power series and the Taylor series of a function – compute the radius of convergence of a power series	HW10, Final Exam

The table below indicates to what extent this course reflects each of the learning objectives of the undergraduate mathematics program. A description of learning objectives is available online at http://www.buffalo.edu/cas/math/ug/undergraduate-programs.html.

Computational Skills:	**Analytical Skills:**	**Practical Problem Solving:**	**Research Skills:**	**Communication Skills:**
extensively	little or not at all	extensively	little or not at all	moderately