Math 306 (Section T): Introduction to Differential Equations; Spring 2015

Instructor: Johanna Mangahas, Assistant Professor
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Office Hours: Thursdays 11:00 am - 12:00 pm *and by appointment*

Class times: Lecture Tuesdays & Thursdays 9:30 - 10:50 am, NSC 205
Recitation T2: Thursdays 3:00 - 3:50 pm, Talbrt 106 **or Baldy 8B for labs**
Recitation T3: Tuesdays 11:00 - 11:50 am, Talbrt 111 **or Baldy 8B for labs**

Textbook: Edwards and Penney, Differential Equations -- Computing and Modeling
2nd UB Custom Edition or 4th Standard Edition, Pearson/Prentice Hall

Software: MAPLE. Free download: myub/computing/software (ubit.buffalo.edu/software)

Prerequisites: MTH 141-142

Description: Analytic solutions, qualitative behavior of solutions to differential equations. First- and higher-order ordinary differential equations, including nonlinear equations. Covers analytic, geometric, and numerical perspectives as well as an interplay between methods and model problems. Discusses necessary matrix theory and explores differential equation models of phenomena from various disciplines. Uses MAPLE to aid in the numerical and qualitative study of solutions, and in the geometric interpretation of solutions.

Grading: Distributed as follows.

• Weekly homework	15%	Due **Mondays** (lowest grade dropped)
• Computer (Maple) labs	15%	During recitation; may be completed at home
• Quizzes	10%	In recitation (lowest grade dropped)
• Midterm 1	15%	In class, February 19
• Midterm 2	20%	In class, April 9
• Final exam	25%	**Wednesday, May 13, 7:15 - 9:15 pm, NSC 216**

Policies: Be warned, **LATE ASSIGMENTS ARE NOT ACCEPTED.** Alternate submission may be arranged when necessary (e.g. e-mail in case of illness, early in case of travel). Quizzes missed for illness/emergency must be made up *within one week, with prior approval* (quizzes may also be taken during the other recitation, with prior arrangement). Requests for make-up exams require official documentation of the need or emergency, will be denied if made later than circumstances permit, and will result in a more difficult test if taken after the original.

Electronics: No electronic devices, including calculators, are allowed during quizzes or exams. Students using electronic distractions during class may be asked to leave.

Academic integrity: Cheating on a quiz will result in a zero (ineligible for being dropped), and zero tolerance from your professor. Cheating on an exam will result in a failing grade and request for dishonesty citation on transcript. University policy is online at: http://undergrad-catalog.buffalo.edu/policies/course/integrity.shtml

Accessibility: Please let me know within the first two weeks of the semester, or as soon as a new condition arises, if you need to arrange accommodations for disability, as supported by UB Accessibility Resources: http://www.student-affairs.buffalo.edu/ods/

Tentative schedule:

Week	**Textbook sections**	**Recitation**	**Deadlines**
1: 1/26 - 1/30	1.1 - 1.4: 1st-order ODEs; soln methods	NONE	
2: 2/2 - 2/6	1.4 - 1.6: 1st-order solution methods	**Lab 1 - Baldy 8B**	2/2: drop/add
3: 2/9 - 2/13	2.2 - 2.4: Stability, Euler's method	Quiz 1	
4: 2/16 - 2/20	3.1: Linear 2nd-order ODEs; **MT 1 (2/19)**		
5: 2/23 - 2/27	3.2 - 3.5: Higher-order solution methods	**Lab 2 - Baldy 8B**	
6: 3/2 - 3/6	3.6, 4.1-2: Resonance; 1st-order systems	Quiz 2 - T2 3/5	
7: 3/9 - 3/13	5.1 - 5.2: Matrices and linear systems	Quiz 2 - T3 3/10	
8: 3/16 - 3/20	**Spring recess**		
9: 3/23 - 3/27	5.2 - 5.4: Linear system sol. methods	**Lab 3 - Baldy 8B**	
10: 3/30 - 4/3	6.1 - 6.4: Nonlinear systems	Quiz 3	
11: 4/6 - 4/10	8.1-2: Power series methods; **MT 2 (4/9)**		
12: 4/13 - 4/17	8.3: Series ctd.; 7.1-2: Laplace transform	**Lab 4 - Baldy 8B**	4/17: resign (R)
13: 4/20 - 4/24	7.3 - 7.4: Transforms continued	Quiz 4 - T2 4/23	
14: 4/27 - 5/1	7.5 - 7.6: Transforms continued	Quiz 4 - T3 4/28	
15: 5/4 - 5/8	Review	Quiz 5	
16: 5/11 - 5/13	**Final exam Wednesday, May 13, 7;15 - 9:15 pm, NSC 216**		

Math 306 (Intro Diff Equations) Section T: Student Learning Outcomes

Assessment measures: 11 homework assignments (H); 4 Maple labs (L); 5 in-recitation quizzes (Q); 2 in-class midterm exams (MT); final exam (F).

At the end of this course, the student should be able to:	Assessment
- understand the concepts of existence and uniqueness of solutions of a differential equation (DE), of general vs. particular solutions, and of initial conditions and initial value problems (IVPs) - sketch slope fields and solution curves - use Maple software to solve 1st-order DEs and IVPs and display solution curves and slope fields - solve 1st order DEs (both nonlinear and linear) using various techniques: separation, integrating factor, substitution methods	H1, H2 L1 Q1 MT1 F
- apply qualitative methods to sketch the solutions of autonomous 1st-order DEs; analyze stability and understand equilibrium solutions - formulate and solve physical problems as 1st- or 2nd- order ODEs - use Euler's method to numerically approximate solutions	H3 L2 MT1 F
- understand the concept of linear independence and determine if functions are linearly independent - understand that linear combinations of linearly independent solutions give the general solution - apply Maple software to solve 2nd-order linear DEs - solve linear, nth-order DEs with constant coefficients, as well as the corresponding IVPs - formulate and solve physical problems related to mechanical vibrations - solve non-homogeneous 2nd order DEs and IVPs using the method of undetermined coefficients - understand "resonance" and "beat" phenomena	H4, H5 L2 Q2 MT2 F
- solve systems of DEs by converting higher-order systems to first-order systems, or vice versa - solve systems of DEs using the method of elimination - review basic notions of linear algebra and use matrices to express systems of DEs - understand and apply fundamental concepts from linear algebra such as linear dependence or independence, spanning set, basis and linear combination, as these ideas relate to DEs - understand and compute eigenvectors and eigenvalues - solve systems of 1st-order DEs using the eigenvalue method and understand behavior of solutions in case of real, complex, and possibly repeated eigenvalues	H6, H7 L3 Q3 MT2 F
- sketch direction fields and indicate stability on the phase plane - perform stability analysis of a linear system using eigenvalues - apply linearization to weakly-nonlinear systems; employ Maple to visualize phase plane and investigate critical points - predict behavior of nonlinear mechanical systems	H8 L4 F
- solve 2nd-order DEs with variable coefficients by applying power-series expansions	H9, Q4, F
- understand and apply Laplace transform methods	H10-11, Q5, F

This course satisfies the Mathematics General Education requirement of the University at Buffalo. By achieving the learning outcomes of this course, students are also achieving the learning outcomes of the SUNY Mathematics General Education requirement:
http://www.suny.edu/provost/academic_affairs/LearningOutcomes.cfm
The above table is based upon the learning outcomes in the sample syllabus provided by the Department of Mathematics, University at Buffalo: http://math.buffalo.edu/undergraduate/undergrad_syllabi.shtml

Notes on MAPLE software:

The four Lab assignments listed on the syllabus are to be written in MAPLE, a standard and extensively-documented mathematical software package. You should be able to complete this assignment during recitation, but may find it convenient to have MAPLE available on a personal computer both for completing lab assignments and for studying the material in general.

ON LAB ASSIGNMENT WEEKS, PLEASE GO TO THE COMPUTER LAB IN BALDY 8B DURING RECITATION. Otherwise, please attend recitation in the classroom listed on your schedule.

In order to solve the MAPLE problems:

1. Please apply for a SENS account(Science and Engineering Node Services). Go to sens.buffalo.edu, then click on "Apply for a SENS Account." This is necessary to log in at the Baldy 8B computer lab.

2. Please download MAPLE 17 or 18 by clicking through MyUB/Computing/Downloads for personally-owned computers. This download is free and the instructions are very clear. Note that you will need the purchase code to complete the download, so please record this alphanumeric sequence (it may appear in an alert window or in a text file in the download package; please follow the most current directions relevant to your computer.

If you have any trouble, please call:

CIT Helpdesk: 716-645-3542

SENS Helpdesk: 716-645-3797