Syllabus: AMATH 351, Autumn 2018

GENERAL INFORMATION
Instructor: Brian de Silva, bdesilva@uw.edu
TA: Ying-Jen Yang, yangyj@uw.edu
Lectures: MWF 10:30-11:20 in MOR 230
Office hours: M 4:00-5:00 and T 5:00-6:00 in LEW 129
TA office hours: MT 3:00-4:00 in LEW 129

WEBPAGE
Homework assignments, solutions, and the gradebook can be found on the canvas course webpage: https://canvas.uw.edu/courses/1218317.

COURSE DESCRIPTION
Introductory survey of ordinary differential equations, linear and nonlinear equations, Taylor series, Laplace transforms, and linear systems of ODEs. Emphasizes formulation, solution, and interpretation of results. Examples drawn from physical and biological sciences and engineering.

PREREQUISITES
Proficiency in manipulation of algebraic equations and methods of differentiation and integration at the level of MATH 124 & 125 are assumed.

TEXTBOOK
W.E. Boyce & R.C. DiPrima, *Elementary Differential Equations and Boundary Value Problems.*
The text is not required, but obtaining some edition of it is to use as a reference is *strongly* recommended. I will also provide a pdf of notes from a previous iteration of the course.

EXAMINATIONS
There will be three in-class examinations and a final, tentatively scheduled as follows:

- Exam 1: Friday, October 19 (week 3)
- Exam 2: Friday, November 9 (week 6)
- Exam 3: Friday, November 30 (week 9)
- Final: Monday, December 10, 8:30-10:20AM (finals week)

Each exam will contain questions from every key skill previously covered in class, giving you multiple opportunities to demonstrate mastery. For example, if exam 1 covered skills 1-4, then exam 2 could have questions from skill 1 and 3-10 (skill 2 is only available through exam 1). The final will include questions from all key skills apart from skill 2.

In addition to the in-class examinations, I will also schedule weekly one-hour sessions outside of class for you to attempt to demonstrate mastery. At the end of each week I will put up an optional poll where you can specify which key skills you would like to be tested on and choose from a list of possible times. I will select the time that works for the most people. I will not hold testing sessions on the weeks when we already have in-class exams (weeks 3, 6, and 9).

No calculators, computers, collaboration, or cheat sheets will be allowed on exams.

GRADES
In this course we will use a mastery-based approach. Associated with the class are 13 key skills. Successful students should demonstrate mastery of all of them by the end of the quarter. Your grade is determined by the number of key skills you master during the course.

Number of mastered skills	Grade
12	4.0
11	3.8
10	3.6
9	3.4
8	3.2
7	3.0
6	2.5
5	2.0
4 and below	0.0

The examinations are your opportunity to demonstrate mastery of the skills. Problems on the examinations will be labeled with corresponding key skills. You need only demonstrate mastery in a particular area *once*. You may attempt to demonstrate mastery multiple times. You will not, in general, be penalized for *when* a skill is mastered.

Non-examination key skills

1. Homework

   ☐ Demonstrating mastery in this category requires earning a satisfactory grade on all homework assignments (see below for what constitutes a satisfactory grade).

Examination key skills

2. Prerequisite knowledge (must be satisfied by or on the first exam)

   ☐ Derivatives: Students are able to differentiate common functions and combinations of common functions using the following techniques.
   - Derivatives of common functions
   - Product/quotient rule
   - Chain rule

   ☐ Integration techniques: Given an integral, student is able to both identify the appropriate method and correctly apply the method to solve it. Students are expected to be familiar with the following methods.
   - Anti-derivatives of common functions
   - (U-) Substitution
   - Integration by parts
   - Partial fractions

   ☐ Students can perform algebraic manipulations (this includes properties of fractions, exponentials, radicals, and logarithms)

3. Fundamental ODE knowledge (mandatory)

   ☐ Student is able to identify ODEs and initial value problems

   ☐ Student is able to determine whether a given function is a solution of a differential equation

   ☐ Student can classify differential equations based on their linearity, coefficients, dimension, order, type (ordinary vs. partial), and homogeneity

   ☐ Student can distinguish between explicit and implicit solutions to ODEs

4. Phase plane and direction field analysis

   ☐ Student is able to draw a qualitatively correct phase plane diagram for a given ODE

   ☐ Student can identify equilibrium points of a first order ODE and classify their stability

   ☐ Student can interpret the direction field of a first order ODE

5. Solving first order ODEs

   ☐ Student can solve a first order ODE using one of the methods from class: integrating factor, method for separable equations, method for exact equations, or substitution

6. Identifying appropriate solution technique

   ☐ Given an ODE, student is able to identify an applicable solution technique or recognize that none of the techniques discussed will work

7. Mathematical modeling

   ☐ Given a description of a physical system or phenomenon, student is able to construct a differential equation which models it

8. Second order linear equation theory

   ☐ Student is able to distinguish between homogeneous, particular, and general solutions to an ODE and explain the differences between them

   ☐ Student is able to explain the superposition principle and use it to find a general solution

   ☐ Student can determine whether or not two functions are linearly independent using the Wronskian or another technique

   ☐ Given one solution to a second order linear ODE, student is able to use Abel's theorem/reduction of order to obtain a second linearly independent solution

9. Ansatz

   ☐ Student can use an ansatz to solve a differential equation

10. Variation of parameters

    ☐ Student can use variation of parameters to solve second order linear constant coefficient ODEs

11. Series solutions

    ☐ Student can identify ordinary points of an ODE

    ☐ Student can find a series solution for a given ODE

12. Laplace transform

    ☐ Student can use the Laplace transform and its fundamental properties to solve second order linear constant coefficient differential equations

The fine print: In order to obtain a passing grade, students must demonstrate mastery in skill 3, i.e. skill 3 is mandatory. Students will only be allowed to demonstrate mastery in skill 1 during the first three weeks of class (up to and including in-class exam 1).

HOMEWORK
Weekly homework assignments will allow students to practice the skills presented in class. Homework assignments will typically be assigned on Wednesdays and will be due a week later. Homework must be submitted as **a single PDF file** on canvas.

Collaboration: Collaboration is encouraged, but every student must submit their own assignment consisting of their own work.

Late assignments: No late assignments will be accepted for any reason. In the rare event of an emergency, with sufficient documentation, a homework will be dropped.

Scoring: Each homework assignment will be graded for completeness, with a few problems selected at random to be graded for correctness. Students are urged to treat each problem seriously, as it is possible any problem will be graded for correctness. A score of 75% or higher will be considered *satisfactory* for key skill 2. The TA will take presentation into account in grading your assignments.

Revisions: Each student may revise up to three homework assignments on which they earned unsatisfactory grades. Revisions must be submitted within a week of when homework assignments are handed back.

ATTENDANCE
Attendance is not recorded nor taken into consideration in grades. However, it is highly recommend that students attend lecture to keep up with the material.

HONOR CODE
Students shall abide by the University of Washington Academic Responsibility policies, which are outlined at `https://depts.washington.edu/grading/pdf/AcademicResponsibility.pdf`

SUGGESTION BOX
If you have a suggestion or any comments on anything related to the course that you do not feel comfortable bringing up with me in person, I have created an anonymous survey. I urge you to bring issues to my attention sooner rather than later. I'll do my best to address your concerns in a timely manner. The survey can be accessed at `https://goo.gl/forms/yCGZYpZgDk051Dzz2`.