MATH 256-103 2018-2019 W1
Differential Equations

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Description: From UBC Calendar: "Linear ordinary differential equations, Laplace transforms, Fourier series and separation of variables for linear partial differential equations."

Prerequisites: Differential calculus (differentiate polynomials, trigonometric functions, fractions etc., product rule, chain rule) and integral calculus (integrate polynomials, basic trigonometric functions, fractions etc., integration by parts, change of variables). Linear algebra (eigenvalues and eigenvectors of matrices). Partial differentiation (chain rule required for starred sections).

Office hours: MWF: 11:30am-12:30pm, 4.30pm - 5.30pm. Both in LSK 303B. Door should be open. Please knock if not.

Assessment: The course will be graded as follows: 16% Homework (8 % Assignments and 8 % Webwork), 34% Two mid-term exams (17 % each), 50% Final exam.

Midterm dates: Midterm One, Oct. 12, 2018; Midterm Two, Nov. 16, 2018

Textbook: The course is *loosely* based on the textbook by Boyce and DiPrima "Elementary Differential Equations and Boundary Value Problems" (any edition). However, this textbook does not replace the lectures, and is not necessary for the course. You might find it useful as a good source of extra worked examples and problem sets. The relevant sections are shown in square brackets in the outline below.

Outline:

0. Introduction

   0.1. Terminology of differential equations [1.3]

1. Linear, first-order, ordinary differential equations (ODEs)

   1.1. Homogeneous, linear, constant coefficient, first-order ODEs
   1.2. Inhomogeneous, linear, constant coefficient, first-order ODEs

1.3. Integrating factors for non-constant coefficient, linear, first-order ODEs [2.1]

2. Nonlinear, first-order ODEs

   2.1. Separable first-order ODEs [2.2]
   2.2. Autonomous first-order ODEs and stability [2.5]
   2.3. Existence and uniqueness (linear vs nonlinear ODEs) [2.4]

3. Linear, second-order ODEs

   3.1. Homogeneous, linear, second-order ODEs [3.1, 3.4, 3.5]
   3.2. Linear-independence and the Wronskian [3.2, 3.3]
   3.3. Inhomogeneous, linear, second-order ODEs [3.6, 3.7]
   3.4. Beating, resonance, and damping [3.8, 3.9]
   3.5. Euler equations [5.5]

4. Higher order linear equations

   4.1. Homogeneous, linear, higher-order ODEs [4.2]
   4.2. Methods of undetermined coefficients and variation of parameters [4.3, 4.4]

5. Systems of first-order ODEs

   5.1. Homogeneous systems of linear, first-order ODEs [7.5, 7.6]
   5.2. Inhomogeneous systems of linear, first-order ODEs [7.9]

6. Laplace Transforms

   6.1. Properties of the Laplace transform [6.1]
   6.2. Solving linear ODEs with the Laplace transform [6.2]
   6.3. Step functions and discontinuous forcing [6.3, 6.4]
   6.4. Impulses [6.5]
   6.5. Convolutions [6.6]

7. Fourier Series

   7.1. Eigenvalue problems [10.1]
   7.2. Properties of sine and cosine [10.2]
   7.3. Writing periodic functions as Fourier series [10.2, 10.4]
   7.4. Fourier sine, cosine series [10.4]

8. Separation of variables for partial differential equations (PDEs)

   8.1. Heat equation for a conducting rod with homogeneous boundary conditions [10.5]
   8.2. Heat equation for a conducting rod with inhomogeneous boundary conditions [10.6]
   8.3. Wave equation for an elastic string [10.7]
   8.4. Laplace equation [10.8]