UNIVERSITY OF BRITISH COLUMBIA

MATH 215/255   FALL 2014

Elementary Differential Equations I / Ordinary Differential Equations

Purpose: This course is an introduction to ordinary differential equations (ODEs) and models that involve ODEs in several areas of application including physics, chemistry, biology, ecology, and engineering. It is expected that a successful student passing this course will:

- understand the background theory of linear systems of ODEs,

- be able to solve analytically a range of first order ODEs and linear second order ODEs,

- be able to understand the qualitative behaviour of some nonlinear ODEs, through the phase plane and methods such as linearization, and

- have familiarity with the concept of numerical solution of an ODE.

Prerequisite: Calculus II (One of MATH 101/103/105/121, SCIE 001) and Linear Algebra (one of MATH 152/221/223).

Corequisite: Calculus III (One of MATH 200/217/226/253/263).

References:

   - **Textbook**: Notes on Diffy Qs: Differential Equations for Engineers, by Jiri Lebl, (online and free, paperback available)

   - **Supplementary text**: A First Course in Differential Equations, 2nd Ed., by J. David Logan (accessible from inside UBC or via VPN)

   - **Optional**: Elementary differential equations and boundary value problems, by W. E. Boyce and R. C. DiPrima, (a nice classical book, ANY version is fine)

Grading:

   - Weekly homework (10%) due Wednesdays with the lowest score dropped (the first is due Sep 17);
   - Two 50-minute midterm exams (20% each) on Wednesdays October 1 and November 5;
   - One 150-minute final exam (50%).
   - Exam marks may be scaled according to the final exam of all sections of MATH 215/255.

Policies:

1. No calculators or notes are allowed in the midterm and final exams.

2. Homework assignments are to be handed in at the beginning of class on Wednesdays. Solutions will be posted on web. A selection of the problems will be graded.

3. Permission to shift the weight of your missed midterms to other exams, or to ignore missed assignments, may be granted only in the following circumstances: (a) prior notice of a valid, documented absence (e.g. out-of-town varsity athletic commitment with a letter from a coach) on the scheduled date; or (b) notification to the instructor of absence due to a medical condition with a doctors note. Otherwise, a score of 0 will be given for the missed midterms/assignments.

Section 103 Instructor: Dr. Chih-Wen Shih, MATX 1115, cwshih1486@math.ubc.ca
                                Office hours: M W 14:30-15:30 (at Leonard S. Klinck Bldg (LSK) 300C).

Section 103 homepage: http://www.math.ubc.ca/~cwshih1486/Course215-255-S103.html
Section 102 homepage: http://www.math.ubc.ca/~ttsai/courses/215-255-14F/

Topics:

- Introduction

1. First order equations   (Ch. 1, 8hr)

   - Integrals as solutions 1.1
   - Slope fields and unique existence 1.2
   - Separable equations 1.3
   - Linear equations and the integrating factor 1.4
   - Exact equations (notes)
   - Autonomous equations 1.6
   - Numerical methods: Euler's method 1.7

2. Second order linear equations   (Ch. 2, 8hr)

   - Second order linear ODEs (method of reduction of order) 2.1
   - Constant coefficient second order linear ODEs (2.2 and notes)
   - Mechanical vibrations 2.4
   - Nonhomogeneous equations (undetermined coefficients and variation of parameters) 2.5
   - Forced oscillations and resonance 2.6

3. Laplace transforms   (Ch. 6, 5hr)

   - Definition and examples 6.1
   - Transforms of derivatives and ODEs 6.2
   - Convolution 6.3
   - Dirac delta and impulse response 6.4

4. Linear systems   (Ch. 3, 7hr)

   - Introduction to systems of ODEs 3.1–3.3
   - Eigenvalue method 3.4
   - Two dimensional systems and their vector fields 3.5
   - Second order systems and applications 3.6
   - Multiple eigenvalues 3.7
   - Matrix exponentials 3.8
   - Nonhomogeneous systems 3.9

5. Nonlinear autonomous planar systems   (Ch. 8, 5hr)

   - Critical points and linearization 8.1
   - Stability and classification of isolated critical points 8.2
   - Applications 8.3

Midterms and review	4 hr
Total	37 hr