MATH 215 -- Elementary Differential Equations I/

MATH 255 -- Ordinary Differential Equations

Session: 2012W Term 1 (Sept.-Dec. 2012)

- **Pre-requisite:** Mathematics 101 (integral calculus) or equivalent, Math 152 (linear algebra) or equivalent
- **Co-requisites (crucial):** Mathematics 200 or 253 (multivariable calculus)
- **Textbook:** Boyce & DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 9th Edition (2008)

SECTIONS:

- **Section 101:** MWF 8-9am, Room: Buchanan A102; instructor: Jun Kitagawa, kitagawa@math.ubc.ca
- **Section 102**: MWF 9-10am, Room: LSK 200; instructor Dixit Harish, hdixit@math.ubc.ca
- **Section 103**: MWF 1-2pm, Room: LSK 200; instructor: Akos Magyar, Math 229E, magyar@math.ubc.ca
- **Section 104**: MWF 1-2pm, Room: LSK 201; instructor: David Steinberg, LSK 126 A , steinberg@math.ubc.ca

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GRADING: Your final grade will be based on your Term mark (50%) and common Final Exam (50%) for all sections. *No notes, books or calculators will be allowed for the Midterms or the Final Exam. Please note that the median Term mark of your section may be scaled to match the median Final mark of your section.*

Midterms: There will be two ***Midterms*** approximately based on weeks 1-4 and weeks 4-9. **See you Section's website for the exact time and location of your Midterms. The** Midterms will worth 30-40% of your overall grade. See your Section for details.

Homework Assignments and/or Quizzes: The will be weekly problem sets which either has to turned in or alternatively short quizzes written in class. The homeworks/quizzes will worth 10-

20% of your overall mark. Please consult your section for details.

Policies: Missing a midterm or an assignment will normally result in a mark of zero. Exceptions may be granted in two cases: prior consent of the instructor or a medical emergency. In the latter case, the instructor must be notified as soon as possible (preferably before the test), and presented with a doctor's note immediately upon the student's return to UBC.

COURSE OUTLINE - SUGGESTED PROBLEMS

I. Introduction

1. Week of September 3: what is a DE, order, linear and nonlinear, solution, general solution, particular solution, direction field

Reading: Chapter 1.
Suggested Problems: **p.9:** 1,6 **p.15:** 7,8,12; **p.24:** 18, 20.

II. First order equations

2. Week of September 10: Solutions of basic first order DE: separable, linear and exact equations

Reading: 2.1, 2.2, 2.6 (no integrating factors)
Suggested Problems: **p.39:**. 3(c), 8(c), 16, 30 **p.47:** 1, 6, 9, 32(b) **p.99:** 1, 2, 13, 15

3. Week of September 17: Modeling with DE, autonomous equations, existence and uniqueness of solutions

Reading: 2.4, 2.3, 2.5
Suggested Problems: **p.75:** 1,3,28 **p.59:** 2, 4, 16, 18b, 23a-c **p.88:** 3, 5, 15, 20 a-c, 22

III. Second order linear equations

4. Week of September 24: Second order linear homogeneous equations, fundamental set of solutions, Wronskian

Reading: 3.1, 3.2.
Suggested Problems: ; **p.144:** 1, 9, 13, 17, 23, 28; **p.155:** 1, 2, 12, 13, 26

5. Week of October 1: Constant coefficient linear homogeneous equations (characteristic equation: double roots, complex roots), linear non-homogeneous equation (method of undetermined coefficients when the homogeneous equations has constant coefficients)

Reading: 3.3, 3.4, 3.5
Suggested Problems: **p.163:** 2, 7, 17, 25 a-c, 35; **p.171:** 1, 14, 23, 25; **p.183:** 1, 8, 17, 27.

6. Week of October 8: ***L***inear non-homogeneous equation (method of variation of parameters), applications to electrical circuits and mechanical vibrations

Reading: 3.6-3.7, **Midterm I: Oct. 12th Friday**
Suggested Problems: **p.189:** 1, 5, 13, 17, 19 ; **p.202:** 3, 7, 11, 12, 17, 18

IV. The Laplace transform

7. Week of October 15: forced vibrations**,** Laplace transform: definition and examples, solution of initial value problems,

Reading: 3.8 (no resonance or beat), 6.1, 6.2
Suggested Problems: **p.215:** 5, 12. **p.311:** 5 a-b, 6, 7, 15; **p.320:** 3, 10, 12, 23

8. Week of October 22: discontinuous functions**,** impulse functions, systems of first order equations

Reading: 6.3, 6.4, 6.5
Suggested Problems:
p.328: 9, 13, 17, 21, 27; **p.336:** 6a-b, 7a-b, 9 **p.343:** 4a-b, 7a-b, 11a;
Calculators can be used for graphing!

V. Systems of first order linear equations

9. Week of October 29: homogeneous case

Reading: 7.5, 7.6, 7.7 (no matrix exponentials)
Suggested Problems:
p.398: 1(a), 4(a), 15, 18, 24, 26, 31; **p.409:** 3, 5, 17 **p.420:** 3a, 6a-b, 12

10. Week of November 5: repeated eigenvalues, non-homogeneous case: undetermined coefficients, variation of parameters, classification of linear systems

Reading: 7.8, 7.9, 9.1
Suggested Problems:
p.428: 2, 4, (for parts a-b you just have to sketch the phase portrait and indicate its type), 6, 8a;
p.439 5, 6, 11 (variation of parameters); 1, 3, 7 (undetermined coefficients)
p.494: 2, 3, 6 (only parts (a) (b) (c) only the phase portraits, don't have to sketch x_1 versus t), 14, 16

VI. Nonlinear systems

11. Week of November 12: Midterm II: Nov. 14th

Reading: 9.2, 9.3 Conservative systems, fixed points, linear approximations to non-linear systems
Suggested Problems:
p.506: 2, 4, 6, 21, 24

12. Week of November 19: Local phase portraits, simple pendulum, competing species

Reading: 9.3, 9.4
Suggested Problems:
p.516: 5, 7, 9, 13, 19a,c (find H(x,y))
p.531: 2(b-e), 4(b-e), 15c,

13. Week of November 26: Predator-Prey equations, Review

Reading: 9.5
Suggested problems: **p.540:** 1(b-e), 4(b-e), 5(b-d)