

**Mathematics 215/255** (3 credits) **Elementary Differential Equations I/Ordinary Differential Equations** Fall Semester 2010

**Pre-requisite:** Mathematics 101 (integral calculus) or equivalent

**Co-requisites (crucial):** Mathematics 200 or 253 (multivariable calculus) or equivalent; Mathematics 221 or 152 (linear algebra) or equivalent

**Textbook:** Boyce & DiPrima, *Elementary Differential Equations and Boundary Value Problems*, 9<sup>th</sup> Edition (2008)

**Section 101:** MWF 8-9am, Room: LSK 201; instructor George Bluman, Math Annex 1112, [bluman@math.ubc.ca](mailto:bluman@math.ubc.ca) (office hours by appointment or try to drop-in)

**Section 102:** MWF 9-10am, Room: McLeod 254; instructor Yana Nec, office location to be determined, [oulanka@math.ubc.ca](mailto:oulanka@math.ubc.ca) (office hours to be determined)

**Section 103:** MWF 1-2pm, Room: LSK 200; instructor Dominik Schoetzau, Math 114, [schoetzau@math.ubc.ca](mailto:schoetzau@math.ubc.ca) (office hours to be determined)

**Section 104:** MWF 1-2pm, Room: Henn 200; instructor Jessica Conway, Math Annex 1110, [conway@math.ubc.ca](mailto:conway@math.ubc.ca) (office hours to be determined)

**Section 105:** MWF 9-10am, Room: DMP 110; instructor Raouf Dridi, Math Annex 1103, [dridi@math.ubc.ca](mailto:dridi@math.ubc.ca) (office hours to be determined)

**Problem Assignments:** due each week *at the beginning* of the Friday class. Problems to be handed-in may be selected from the indicated *Suggested Problems*.

**Midterms:** There will be three in-class midterms tentatively scheduled to be held on October 4 (based on weeks 1-3), October 25 (based on weeks 4-6), November 19 (based on weeks 7-10).

**Grading:** 45% from the midterms + homework assignments; 55% from the Final Exam. *You must have a passing grade on the best nine of 11 homework assignments and pass the Final Exam to pass this course. No notes, books or calculators will be allowed for in-class midterms or the Final Exam.* If you miss a midterm with a valid reason, then your term mark (45%) will be based on the other two midterms + homework assignments.

## **COURSE OUTLINE—tentative**

### **I. Introduction**

**1. Week of September 6:** what is a DE, order, linear and nonlinear, solution, general solution, particular solution

*Reading:* Chapter 1.

*Suggested Problems:* p.15: 1(a), 3, 4, 8, 13, 15, 17, 18; p.24: 18, 20.

### **II. First order equations**

**1. Week of September 6 cont'd:** solution of linear ODE, direction field

*Reading:* 2.1

*Problems:* p.39: 5, 11, 14, 21, 24, 32.

**2. Week of September 13:** existence and uniqueness, integrating factors, separable equations, symmetry, homogeneous equations, applications

*Reading:* 2.4, 2.6, 2.2, 2.3, 2.5

*Suggested Problems:* p.75: 3, 25, 27; p.99: 13; p.47: 1, 6, 30, 34; p.59: 8, 9, 10, 16, 18, 32; p.88: 15, 20, 22, 24, 28.

### III. Second order linear equations

**3. Week of September 20:** linear operator, existence and uniqueness, linear independence, linear homogeneous equation, linear nonhomogeneous equation

*Reading:* 3.1, 3.2.

*Suggested Problems:* p.144: 1, 9, 13, 17, 23, 28; p.155: 1, 2, 46, 51.

**4. Week of September 27:** Wronskians and linear independence (fundamental set of solutions), constant coefficient linear homogeneous equations (characteristic equation: real roots, double roots, complex roots), linear nonhomogeneous equation (method of undetermined coefficients when the homogeneous equations has constant coefficients)

*Reading:* 3.2-3.5

*Suggested Problems:* p.163: 2, 7, 17, 25, 29, 32, 34; p.171: 1, 14, 23; p.183: 1, 8, 17, 28, 29.

**5. Week of October 4: *midterm*;** linear nonhomogeneous equation (method of variation of parameters), applications to electrical circuits and mechanical vibrations

*Reading:* 3.6-3.8

*Suggested Problems:* p.189: 1, 5, 19, 21, 28, 29; p.202: 5, 15, 16, 19, 20, 30; p.215: 1, 5, 17.

### IV. The Laplace transform

**6. Week of October 11:** definition and examples, solution of initial value problems,

*Reading:* 6.1-6.4

*Suggested Problems:* p.311: 5, 6, 14, 18, 26, 27; p.320: 2, 11, 20, 24, 27(a,b), 28, 30, 37; p.328: 13, 25, 29, 30, 33, 34; p.336: 1, 10, 19.

**7. Week of October 18:** discontinuous functions, impulse functions, convolutions.

*Reading:* 6.5, 6.6

*Suggested Problems:* p.343: 1, 25; p.350: 1, 7, 13, 21, 22, 29.

### V. Systems of first order linear equations

**8. Week of October 25: *midterm*;** homogeneous case

*Reading:* 7.5, 7.6, 7.8

*Suggested Problems:* p.398: 1, 15, 29, 32, 33; p.409: 1, 26, 28; p.428: 1.

**9. Week of November 1:** nonhomogeneous case

*Reading:* 7.9

*Suggested Problems:* p.439: 1, 3.

### VI. Nonlinear systems

**10. Week of November 8:** introduction.

*Reading:* 9.1, 9.2

*Suggested Problems:* p.494: 1(a-c), 17, 20, 21; p.506: 1, 3, 17, 21, 23.

**11. Week of November 15: *midterm*;** example of simple pendulum

*Reading:* 9.3-9.5

*Suggested Problems:* p.516: 1-6, 19, 21, 22, 27.

**12. Week of November 22:** critical points, linearization, physical examples

### VII. Catch-up? and/or review?

**13. Week of November 29:** may be used for lectures to catch-up on schedule—otherwise for review