Florida International University

SYLLABUS
MAP 2302 - DIFFERENTIAL EQUATIONS

Updated: Fall 1989

TEXT: INTRODUCTION TO ORDINARY DIFFERENTIAL EQUATIONS, 4TH ed.
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The following syllabus assumes that the semester includes 28 classes, each meeting for 1 hour, 15 minutes. The essence of the course is contained in Chapters 2,4, 6 and 9, with applications chosen from Chapters 3 and 5.

PREREQUISITE: Emphasize to the students that a good command of the differentiation formulas and of the standard techniques of integration covered in CALCULUS II is necessary for this course and therefore they must review them. A brief introduction to partial derivatives must be presented by the instructor in the course since they are not covered in CALCULUS II.

CHAPTER I: (1 LECTURE) Introduce the concept of a differential equation and its order. Distinguish between ordinary and partial differential equations. Explain the difference between explicit and implicit solutions and how to check each of these. Discuss initial value problems and boundary value problems.

CHAPTER 2: (4 LECTURES) Solutions of the basic types of first order equations, including a) exact equations; b) separable equations; c) homogeneous equations; d) linear equations; e) Bernoulli equations; f) equations with linear coefficients.

CHAPTER3: (1 LECTURE) Choose some applications of first order equations from among orthogonal trajectories, falling body problems, growth & decay problems, and/or mixture problems.

CHAPTER 4: (6 lectures) a) Introduce the basic theory and terminology of linear ODE's; statement of the initial value existence theorem; general solution of homogeneous equations; the Wronskian and its use; particular and complementary solutions. b) General solution to the linear homogeneous equation with constant coefficients and its various cases. c) The technique of undetermined coefficients. d) The technique of variation of parameters. e) The technique of reduction of order. [Note: Some Wronskian, where this technique occurs in the book.] f) The solution to the Cauchy-Euler equation.

[NOTE: Many concrete examples should be given. Most emphasis should be placed on 2nd order

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equations, with indications and, perhaps examples, of what happens in some higher order cases.]

CHAPTER 5: (1 LECTURE) Application of 2^{nd} order linear equations to a mass on a spring, especially the free undamped and damped cases.

[NOTE: Some instructors choose to leave this section until after Laplace transforms are covered.]

CHAPTER 6: (5 LECTURES) a) Brief review of power series and their properties; change of indices in summations. b) Define ordinary and singular points; state the existence theorem for power series solutions at ordinary points; work out examples showing how the recurrence relation is obtained and used to find solutions. c) Define regular singular points and state the existence theorem for solutions at such points; work out examples finding Frobenius series solutions. d) Discuss, and perhaps give an example, of using reduction of order to find another solution when only one Frobenius series solution is found.

[NOTE: In this chapter, stress the formal manipulation of series, but point out that questions of convergence are also important.]

CHAPTER 9: (7 LECTURES)

9.1A) Definition and existence of the Laplace transform and some elementary computations.

9.1B) Basic properties: linearity and the Laplace transforms of

i) $f'(t)$ ii $f^{(n)}(t)$ iii) $e^{at} f(t)$ iv) $t^n f(t)$

9.2A) The inverse transform, use of a table and of partial fractions for finding inverse transforms.

9.2B) The convolution and its Laplace transform; use of convolution to find inverse transforms.

9.3) Use of Laplace transforms to solve linear differential equations.

9.4A) Step functions, translated functions and periodic functions, and their Laplace transforms.

9.4B) Inverse transform of functions of the form $e^{-as}F(s)$.

9.4C) Use of Laplace transforms to solve linear differential equations with discontinuous non-homogeneous terms.

9.5) Use of Llaplace transforms to solve linear systems of differential equations.

It is recommended that 3 one hour-fifteen minute, in-class exams be given. The final exam is scheduled for two and one-half hours and should be comprehensive. No calculators or integral tables should be allowed during the examinations.