MATH 245 - Mathematics of Physics and Engineering I

Spring 2016

TEXT: Differential Equations: An Introduction to Modern Methods and Applications, Third Edition, by James R. Brannan and William E. Boyce, published by Wiley.

CHAPTER 1: INTRODUCTION. Sections 1.1 to 1.3. Some examples. Phase lines and direction fields. Classification of differential equations. (1 lecture).

CHAPTER 2: FIRST ORDER DIFFERENTIAL EQUATIONS. Sections 2.1 to 2.6. Separable equations, linear equations and integrating factors, autonomous equations, exact equations and integrating factors. Brief discussion of existence and uniqueness of solutions. Applications (including population dynamics). (7 lectures).

CHAPTER 4: SECOND ORDER LINEAR EQUATIONS. Sections 4.1 to 4.7. Examples. General theory, fundamental solutions and the Wronskian. Explicit solutions for homogeneous equations with constant coefficients. Applications to mechanical and electrical vibrations. Particular solutions for non-homogeneous equations. Forced vibrations. Variation of parameters. (8 lectures)

CHAPTER 3: SYSTEMS OF TWO FIRST ORDER EQUATIONS. Sections 3.1 to 3.6. 2×2 systems of linear equations, eigenvalues and eigenvectors. Existence and uniqueness of solutions for linear and nonlinear systems. Homogeneous linear systems with constant coefficients: distinct real eigenvalues, complex eigenvalues, repeated eigenvalues. (6 lectures)

CHAPTER 6: SYSTEMS OF FIRST ORDER LINEAR EQUATIONS. Sections 6.1 to 6.6. Matrices. General theory of fundamental solutions and the Wronskian. Fundamental matrix solution. Explicit solutions for homogeneous and non-homogeneous equations with constant coefficients. (6 lectures)

CHAPTER 5: THE LAPLACE TRANSFORM. Sections 5.1 to 5.8. Definition and basic properties. Solution of initial value problem for constant coefficient linear differential equation using the Laplace transform. Discontinuous and impulse forcing (Dirac delta function). Convolution and the transfer function. (7 lectures)

CHAPTER 7: NONLINEAR DIFFERENTIAL EQUATIONS AND STABILITY. Sections 7.1 to 7.4. Phase portraits. Autonomous 2-dim systems and stability. Linear and almost linear systems. Competing species and predator-prey models. (4 lectures)

Additionally, there may be some discussion of numerical methods for the solution of ordinary differential equations, and some homework assignments requiring the use of the computer package MATLAB.

The number of lectures on each chapter is a suggestion. Some professors may spend more time on some topics and less on others. The suggested total of 40 lectures leaves some time available for midterm tests and review.