American University of Kurdistan

Advanced Engineering Mathematics

Syllabus – Spring 2020

Course Description: Ordinary and Partial Differential Equations, First- and second-order

equations; series solutions; Laplace transform solutions; higher order equations; Introduction to Partial Differential Equations and Fourier Series.

Instructor: Daner Ferhadi

Prerequisite: Calculus III, Linear Algebra

Textbook: Elementary Differential Equations and Boundary Value Problems, 11th edition, W. E.

Boyce, R.C. Diprima, and D.B. Meade

Examinations: One 120-minute midterm examinations and a comprehensive final examination given during the final examination period.

Calculators: A calculator may be useful for some homework problems involving graphing.

However, the use of calculators is not permitted on exams.

Grading Policy: Grades will be assigned on the basis of 400 points distributed as follows

100 points midterm examination I

150 points quizzes/homework

150 points final examination

Course Learning Objectives:

These are outlined in the schedule of courses at the end of this syllabus. Students should come to understand that mathematical modeling is often necessary in order to understand and describe physical phenomena with variant accuracy. They should come to see that in mathematical modeling, differential equations often present themselves. Students should have a general understanding of mathematical modeling using first order and second order linear ordinary differential equations, they should be able to solve homogeneous equations of higher order with constant coefficients. They should be able to use separation of variables to show the solution to the wave equation. The course will emphasize qualitative methods and quantitative methods for analyzing differential equations and mathematical modeling. Please see the course outline below for further detail.

Course Learning Outline:

1. INTRODUCTION

1.1 Direction Fields (1 class period)

1.2 Solution of Some Differential Equations (1)

1.3 Classification of Differential Equations (.5)

2. FIRST ORDER DIFFERENTIAL EQUATIONS

2.1 Linear Equations with Variable Coefficients (2)

2.2 Separable Equations (1)

2.3 Modeling with First Order Equations (cover mixing problems, plus either motion with air resistance, compound interest, or Newton's law of cooling) (3)

2.4 Differences Between Linear and Nonlinear Equations (1)

2.5 Autonomous Equations and Population Dynamics (cover stability of equilibrium solutions) (2)

2.6 Exact Equations (omit Integrating Factors) (1.5)

3. SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

3.1 Homogeneous Equations with Constant Coefficients (1)

3.2 Solutions of Linear Homogeneous Equations; Wronskian (2)

3.3 Complex Roots of the Characteristic Equations (1)

3.4 Repeated Roots; Reduction of Order (1.5)

3.5 Nonhomogeneous Equations; Method of Undetermined Coefficients (3)

3.7 Mechanical and Electrical Vibrations (2)

3.8 Forced Vibrations (w/o damping) (1)

4. HIGHER ORDER LINEAR EQUATIONS

4.1 General Theory of n-th Order Linear Equations (.5)

4.2 Homogeneous Equations with Constant Coefficients (1)

6. THE LAPLACE TRANSFORM

6.1 Definition of the Laplace transform (1)

6.2 Solution of Initial Value Problems (2)

6.3 Step Functions (1)

6.4 Differential Equations with Discontinuous Forcing Functions (2)

6.5 Impulse Functions (1)

7. SYSTEMS OF TWO LINEAR DIFFERENTIAL EQUATIONS

7.1 Introduction to Systems of Differential Equations (1)

7.2-7.3 Introduction to 2 x 2 Matrices (1.5)

7.5, 7.6, 7.8 2 x 2 Linear Systems of Differential Equations (3)

9. NONLINEAR DIFFERENTIAL EQUATIONS AND STABILITY (If time permits)

9.1 Phase Portraits of 2 x 2 Linear Systems (1)

9.2 Autonomous Systems and Stability (.5)

9.3 Locally Linear Systems (.5)

9.5 Predator-Prey Equations (1)

10. PARTIAL DIFFERENTIAL EQUATIONS AND FOURIER SERIES

10.1 Two-Point Boundary Value Problems (2)

10.2 Fourier Series (2)

10.3 The Fourier Convergence Theorem (1)

10.4 Even and Odd Functions (1.5)

10.5 Separation of Variables; Solutions of Heat Conduction Problems (2)

10.7 The Wave Equation: Vibrations of an Elastic String (2)

10.8 Laplace's Equation (2)

This schedule is subject to change.