

Table of Contents

1. Differential Equations	5
1.1 Basic Concepts	5
1.2 Some Important Differential Equations	9
1.3 First Order Differential Equations.....	15
Separable Differential Equations	15
Linear Differential Equations	22
1.4 Second Order Linear Differential Equations.....	31
Homogeneous Second Order Linear Differential Equations.....	31
Homogeneous Equations with Constant Coefficients.....	33
The <i>RLC</i> Circuit and the Spring.....	37
Nonhomogeneous Second Order Linear Differential Equations.....	41
Particular Solution by the Method of Undetermined Coefficients.....	43
Initial Value Problems for Second Order Equations.....	48
Electric Circuit Applications	50
Answers, Chapter 1 – Differential Equations.....	60
2. Solving Differential Equations by Computer	67
2.1 Solving Differential Equations Using Maple	67
2.2 Solving Differential Equations Numerically	68
Euler’s Method	68
The Runge-Kutta Method	69
3. Laplace Transforms.....	79
3.1 Introduction	79
3.2 The Step and Delta Functions	81
The Unit Step Function.....	82
The Unit Impulse or Dirac Delta Function	86
3.3 The Laplace Transform	90
3.4 The Inverse Laplace Transform	102
Direct Use of the Table	102
Completing the Square.....	103
Breaking up a Fraction.....	103
Partial Fractions Decomposition.....	105
3.5 Applications of Laplace Transforms	111
Solving a Differential Equation	111
Solving a System of Differential Equations.....	115
Analysing Electric Circuits in the <i>s</i> - Domain	124
Loop Analysis of Networks in the <i>s</i> - Domain.....	130
3.6 Systems	136
The Transfer Function	136
The Complex <i>s</i> - Plane.....	145
System Stability and <i>s</i> -plane Geometry	149
Stability of a transfer function having a quadratic denominator	151
The Convolution Integral.....	154
Answers, Chapter 3 – Laplace Transforms	158

4. Difference Equations	165
4.1 Discrete-time Systems, Signals and Variables	165
4.2 Differences and Difference Equations	167
Answers, Chapter 4 – Difference Equations	177
5. z - Transforms	179
5.1 The z-Transform	179
5.2 The Inverse z-Transform.....	186
5.3 Systems and Transfer Functions	191
5.4 The Complex z-plane	193
5.5 System Stability and z - plane Geometry	198
5.6 Low-Pass Digital Filter	200
5.6 High-Pass Digital Filter	203
Answers, Chapter 5 – z-Transforms.....	206
Appendix A Table of Laplace Transforms	209
Appendix B Table of z-Transforms.....	211