

Chapter 1. Modeling with Ordinary Differential Equations

1. What Is An Ordinary Differential Equation?
2. Mass-Spring System
3. Ordinary Differential Equation Of The Damped System
4. Over Damping
5. Under Damping
6. Modeling Beam Deflection
7. Exercises

Chapter 2. Euler-Cauchy equation

1. Case 1: Roots Are Real And Distinct
2. Case 2: Roots Are Real And Equal
3. Case 3: Roots Are Complex Conjugate
4. Non-Homogeneous Euler-Cauchy Equation.
5. Exercises

Chapter 3. Special Function: The Gamma, Beta And Error Functions

1. The Gamma Function
2. Specific Values For The Gamma Function Involving Factorials.
3. The Beta Function
4. Symmetry Of The Beta Function
5. Beta And Gamma Function.
6. The Beta Integral
7. Error Function
8. Complementary Error Function
9. Exercises

Chapter 4. Periodic Functions And Fourier Series

1. Periodic Functions
2. Non Sinusoidal Periodic Functions
3. Fourier Series
4. Fourier Series Coefficients

5. Even And Odd Function:
6. Cosine And Sine Functions
7. Properties Of Even And Odd Functions
8. Cosine Series
9. Sine Series
10. Half-Range Expansions
11. Complex Fourier Series
12. Converting Between Real And Complex Function
13. Exercises

Chapter 5. Power Series: Legendre Functions & Polynomials

1. Power Series Method
2. Power Series Review
3. Solving Ode's With Power Series
4. Legendre's Equation
5. Legendre Polynomials
6. Properties Of Legendre Polynomials.
7. Fourier –Legendre Series
8. Frobenius Methods:
9. Extended Power Series
10. Frobenius Solutions: The Indicial Equation
11. Exercises

Chapter 6. Partial Differential Equation

1. The Wave Equation-Modelling A Vibrating String
2. Partial Derivative Review
3. Important Partial Differential Equations
4. The Wave Equation
5. Modeling The Vibrating Spring

6. Derivation Of The Wave Equation
7. Solution Of The Wave Equation By Separation Of Variations.
8. Dalember Solution Of The Wave Equation
9. Exercises

Chapter.7 The Heat Equations

1. Solution Of The Heat Equation:
2. Bar Ends Temperature =Zero.
3. Bar Ends Are Insulated
4. Steady State System
5. The Laplace's Equation
6. Steady Two Dimensional Heat Equation
7. Dirichlet Problem Of A Rectangle
8. Laplace's Equation In The Polar Coordinate System
9. Dirichlet Problem For A Circular Area (Disk)
- 10.Exercises

Chapter 8. Orthogonal And Orthonormal System

1. Sturm-Liovville Problem Ems
2. Orthogonal-Orthonormal Functions
3. Orthogonal System
4. Orthomormal Syestem
5. Normalization Of A Function
6. Orthogonal Set Of Functions With Respect To A Weight Function $W(X)$.
7. Examples Of Orthogonal Polynomials
8. Legendre Ploynomials
9. Laguerre Ploynomials
- 10.The Sturm-Liouville Differential Equation
- 11.The –Sturm-Liouville Problem

12.The Regular Sturm-Liouville Problem

13.The Singular Sturm-Liouville Problem

14.Rewriting Eigenvalue Problem into A Sturm-Liouville Form

15.Exercise

Chapter 9. First Kind Bessel's Equation

1. Bessel's Function of The First Kind

2. Bessel Function Of The First Kind $J_\nu(X)$

3. Bessel Function of The First Kind And Order (ν).

4. Derivatives and Recurrence Formulas of Bessel Functions

5. Integration and Integral Identities of Bessel Functions.

6. More Relation on Bessel Functions

7. Modified Bessel Function

8. Exercises

Chapter 10. Second Kind Bessel's Equation

1. Bessel's Function Of The Second Kind

2. Properties Of Bessel Function Of The Second Kind

3. Equations Reducible To Bessel Functions

4. Modified Bessel Function Of The Second Kind

5. Exercises

CHAPTER 11 - MAPLE-SOFTWARE

1. Getting Started

2. Piecewise Functions

3. Ordinary Differential Equations

4. Legendre Functions

5. Bessel Functions

6. Miscellaneous Examples on Maple

References

Tables

appendi