

HELM Resources : Please find the section(s) you are interested in from the list below.

1: Basic Algebra

1.1 Mathematical notation and symbols

1.2 Indices

1.3 Simplification and Factorisation

1.4 Arithmetic of Algebraic Fractions

1.5 Formulae and Transposition

2: Functions

2.1 Basic concepts of functions

2.2 The graph of a function and parametric form

2.3 One to one and inverse functions

2.4 Characterising Functions

2.5 The Straight Line

2.6 The Circle

2.7 Some common engineering functions

3: Polynomials, inequalities and partial fractions

3.1 Solving linear equations

3.2 Solving quadratic equations

3.3 Solving polynomial equations

3.4 Solving simultaneous linear equations

3.5 Solving inequalities

3.6 Partial fractions

4: Trigonometry

4.1 Right Angled Triangles

4.2 Trigonometric Functions

4.3 Trigonometric Identities

4.4 Applying Trigonometry to Triangles

4.5 Applying Trigonometry to Waves

5: Functions and Modelling

5.1 The Modelling Cycle and Functions

5.2 Quadratic Functions and Modelling

5.3 Oscillating Functions and Modelling

5.4 Inverse Square Functions and Modelling

6: Logarithms and exponentials

6.1 The exponential Function

6.2 The hyperbolic function

6.3 Logarithms

6.4 The logarithm function

6.5 Log-linear graphs

6.6 Modelling Exercises

7: Matrices

7.1 Introduction to matrices

7.2 Matrix multiplication

7.3 Determinants

7.4 The inverse of a matrix

8: Using matrices and determinants to solve equations

8.1 Cramer's rule for solving simultaneous equations

8.2 Solving simultaneous equations using the inverse matrix

8.3 Gauss elimination

9: Vectors

9.1 Basic concepts of vectors

9.2 Cartesian components of vectors

9.3 The Scalar Product

9.4 The Vector product

9.5 Vectors, Lines and Planes

9.6 Vectors and Electrostatics

10: Complex numbers

10.1 Complex arithmetic

10.2 Argand diagrams and polar form

10.3 Exponential form

10.4 De Moivre's theorem

11: Differentiation

11.1 Introducing differentiation

11.2 Using a table of derivatives

11.3 Higher derivatives

11.4 Differentiating Products and Quotients

11.5 The Chain Rule

11.6 Parametric Differentiation

11.7 Implicit Differentiation

12: Applications of differentiation

12.1 Tangents and Normals

12.2 Maxima and Minima

12.3 The Newton Raphson Method

12.4 Curvature

12.5 Differentiation of Vectors

12.6 Case Study : Complex Impedance

13: Integration

13.1 Basic Concepts of Integration

13.2 Definite Integrals

13.3 The Area bounded by a Curve

13.4 Integration by Parts

13.5 Integration by Substitution and by Partial Fractions

13.6 Integration of Trigonometric Functions

14: Applications of Integration I

14.1 Integration of the Limit of a Sum

14.2 Mean Value and RMS Value

14.3 Volumes of Solids of Revolution

14.4 Lengths of Curves and Areas of Surfaces of Revolution

14.5 Integration by Substitution and using Partial Fractions

15: Applications of integration II

15.1 Integrals involving vectors

15.2 Calculating centres of mass

15.3 Moment of inertia

16: Sequences and series

16.1 Sequences and series

16.2 Infinite series

16.3 The binomial series

16.4 Power series

16.5 Maclaurin and Taylor series

17: Conic sections

17.1 Conic sections (circle, ellipse, parabola and hyperbola)

17.2 Polar co-ordinates

17.3 Parametric curves

18: Functions of several variables

18.1 Functions of several variables

18.2 Partial derivatives

18.3 Stationary points

18.4 Errors and percentage change

19: Differential equations

19.1 Modelling with differential equations

19.2 First Order Ordinary Differential Equations

19.3 Second Order Ordinary Differential Equations

19.4 Applications of Differential Equations

20: The Laplace transform

20.1 Causal functions

20.2 The transform and its inverse

20.3 Further Laplace transforms

20.4 Solving differential equations

20.5 The convolution theorem

20.6 Transfer functions

21: z-Transforms

21.1 The z-Transform

21.2 Basics of z-Transform Theory

21.3 z-Transforms and Difference Equations

21.4 Engineering Applications of z-Transforms

21.5 Sampled Functions

22. Eigenvalues and Eigenvectors

22.1 Basic Concepts

22.2 Applications of Eigenvalues and Eigenvectors

22.3 Repeated Eigenvalues and Symmetric Matrices

22.4 Numerical determination of Eigenvalues and Eigenvectors

23: Fourier Series

23.1 Periodic Functions

23.2 Representation of Periodic Functions by Fourier Series

23.3 Even and Odd Functions

23.4 Convergence

23.5 Half Range Series

23.6 The Complex Form

23.7 Applications of Fourier Series

24: Fourier Transforms

24.1 The Fourier Transform

24.2 Properties of the Fourier Transform

24.3 Some Special Fourier Transform Pairs

25: Partial Differential Equations

25.1 Partial Differential Equations

25.2 Applications of PDEs

25.3 Separation of Variables

25.4 Solution by Fourier Series

26: Functions of a Complex Variable

26.1 Complex Functions

26.2 Cauchy-Riemann Equations and Conformal Mapping

26.3 Standard Complex Functions

26.4 Basic Complex Integration

26.5 Cauchy's Theorem

26.6 Singularities and Residues

27: Multiple Integration

27.1 Introduction to Surface Integrals

27.2 Multiple Integrals over Non-rectangular Regions

27.3 Volume Integrals

27.4 Changing Coordinates

28: Differential Vector Calculus

28.1 Background to Vector Calculus

28.2 Differential Vector Calculus

28.3 Orthogonal Curvilinear Coordinates

29: Integral Vector Calculus

29.1 Line Integrals Involving Vectors

29.2 Surface and Volume Integrals

29.3 Integral Vector Theorems

30: Introduction to Numerical Methods

30.1 Rounding Error and Conditioning

30.2 Gaussian Elimination

30.3 LU Decomposition

30.4 Matrix Norms

30.5 Iterative Methods for Systems of Equations

31: Numerical Methods of Approximation

31.1 Polynomial Approximation

31.2 Numerical Integration

31.3 Numerical Differentiation

31.4 Non-linear Equations

32. Numerical Initial Value Problems

32.1 Initial Value Problems

32.2 Linear Multistep Methods

32.3 Predictor-Corrector Methods

32.4 Parabolic PDEs

32.5 Hyperbolic PDEs

33: Numerical Boundary Value Problems

33.1 Two Point Boundary Value Problems

33.2 Elliptic PDEs

34: Modelling Motion

34.1 Projectiles

34.2 Forces in more than one dimension

34.3 Resisted Motion

35: Sets and Probability

35.1 Sets

35.2 Elementary Probability

35.3 Addition and Multiplication Laws of Probability

35.4 Total Probability and Bayes' Theorem

36: Descriptive Statistics

36.1 Describing Data

36.2 Exploring Data

37: Discrete Probability Distributions

37.1 Discrete Probability Distributions

37.2 The Binomial Distribution

37.3 The Poisson Distribution

37.4 The Hypergeometric Distribution

38: Continuous Probability Distributions

38.1 Continuous probability distributions

38.2 The uniform distribution

38.3 The Exponential Distribution

39. The normal distribution

39.1 The normal distribution

39.2 The normal approximation to the binomial distribution

39.3 Sums and differences of random variables

40: Sampling Distributions and Estimation

40.1 Sampling Distributions and Estimation

40.2 Introduction to Confidence Intervals

41: Hypothesis Testing

41.1 Statistical Tests

41.2 Tests concerning a single sample

41.3 Tests concerning two samples

42: Goodness of Fit and Contingency Tables

42.1 Goodness of Fit

42.2 Contingency Tables

43: Regression and Correlation

43.1 Regression

43.2 Correlation

44: Analysis of Variance

44.1 One-Way Analysis of Variance

44.2 Two-Way Analysis of Variance

44.3 Experimental Design

45: Non-parametric Statistics

45.1 Non-parametric Tests for a single sample

45.2 Non-parametric Tests for two samples

46 : Reliability and Quality Control

46.1 Reliability

46.2 Quality Control

47: Mathematics and Physics Miscellany

47.1 Dimensional Analysis in Engineering

47.2 Mathematical Explorations

47.3 Physics Case Studies

48: Engineering Case Studies

48.1 Engineering Case Studies

49: Students' Guide

49.1 Students' Guide

50: Tutor's Guide

50.1 Tutor's Guide