

Contents

<i>Foreword</i>	(vii)
<i>Message</i>	(ix)
<i>Preface</i>	(xi)

Chapter 1

Vector Spaces

Vector space	1
General Properties of vector spaces.....	5
Vector Subspaces	7
Algebra of subspaces	11
Linear combination	13
Linear span.....	13
Linear dependence and linear independence	13
Basis of vector space.....	16
Linear transformation	18
Range and null space of a Linear Transformation	19
Rank and nullity of a Linear transformation.....	20
Representation of transformation by matrices	22

Chapter 2**Hermite Polynomials**

Recurrence Relations	27
The Rodrigues formula $H_n(x)$	30
Brafman generation function	33
The Hermite polynomial as 2 Fo	34
Intrgral Representation	35
Curzon's Integral for $P_n(x)$	35
Orthagonal Property	36
Expansion of polynomials	39
More Generating function	40
Bilinear Generating function	41

Chapter 3**Functions**

Hash Function	43
Applications of Hash Function	43
Properties of Hash Function	44
Perfect Hashing	45
Minimal Perfect hashing	45
Origin of from "Hash"	45
Heaviside step Functions	45
Error Function	47
Inverse error Function	49
Modular Mathematics	51
Simultaneous equations	52

Chapter 4**Solution of Partial Differential Equations**

Method of Separation of variable	55
One dimensional heat how equation	62

Solution of one dimensional wave equation (by separation of variable)	62
De-Almbert's solution	66
Solution of one dimensional heat flow equation.....	73
Two dimensional wave equation (Vibrating membrane).	81
Solution of two dimensional wave equation (Rectangular membrane)	82
Solution of two dimensional wave equation (Circular membrane)	84
Laplace equation in three dimensions.....	91

Chapter 5

Numerical Solution of Partial Differential Equations

Classification of second order partial differential equations	97
Finite differential approximations to partial derivatives	99
Elliptic equations	100
Solution of Laplace equation	100
Solution of Poisson's equation	109
Solution of elliptic by relaxation method.....	113
Parabolic Equation (Heat equation)	119
Schmidt method	119
Crank – Nicolson method	119
Iterative method	120
Du-ford and frankel method	120
Solution of two dimensional heat equation.....	127
Hyperbolic equations	129

Chapter 6

Fourier Transform

Fourier Integral formula.....	139
Fourier sine and cosine integrals	139
Fourier Transforms	140
Properties of Fourier Transform	141
Inversion theorem for complex Fourier Transform	143

Multiple Fourier Transforms	149
Convolution	150
Convolution theorem for Fourier Transform (Felting theorem)	150
Perseval's Identity for Fourier Transforms.....	150
Relationship between Fourier and Laplace Transforms	151
Fourier Transforms of the derivatives of a Function	152
Finite Fourier sine Transforms	154
Finite Fourier cosine Transforms.....	154
Application of Fourier Transforms to boundary value problems	157

Chapter 7

The Discrete Fourier Transform

The Discrete Fourier Transform	168
The DFT as a Linear Transformation	170
Properties of the DFT	173
Modulo N -Operation.....	175

Chapter 8

Wavelet and Haar Transform

Introduction.....	180
Merlot's wavelet	180
Mother wavelet	182
The continuance wave transform (CWT)	182
Application of wavelet transform	183
Haar Transform.....	183

Chapter 9

Theory of Probability

Introduction.....	185
Random Experiment	185
Sample Point	185

Sample space	185
Discrete sample space.....	185
Continuous sample space.....	186
Event.....	186
Type of events.....	186
Addition theorem of probabilities.....	187
Conditional Probability.....	189
Multiplication theorem (Theorem of compound probability).....	189
Probability compound Event theorem	198
Bay's Theorem.....	199
Discrete Random variable.....	202
Continuous Random variable.....	203
Probability functions of a Discrete Random variable	203
Mathematical expectation	203

Chapter 10

Theoretical Distribution

Theoretical Distribution.....	214
Binomial Distributions.....	214
Constants of Binomial Distribution	215
Recurrence Formula	218
Moment Generating Function	219
Cumulate Generation Function	220
Poisson Distribution	233
Constants of Poisson Distribution	234
Recurrence formula for Poisson distribution	236
Normal Distribution	246
Properties of the normal distribution	252
Constant of normal distribution	252
Moment Generating function	260
Fitting of Normal Distribution.....	267

Chapter 11**Sampling Distribution (Large Samples)**

Introduction	274
Type of sampling	274
Sample of Attributes	274
Simple sampling	275
Mean and Standard deviation in simple sampling of Attributes	275
Test of significance for large samples	275
Standard error	276
Probable error	276
Comparison of two large samples	282
Sampling Distribution	288
Standard error of sampling distribution of means	288
Distribution of the difference between two sample means	289
Test of significance for means	290
Test of significance of the means of two large samples	291
Fiducial or confidence limits	291
Some standard error of other parameters	292

Chapter 12**Theory of Estimation**

Introduction.....	300
Point Estimation	300
Interval estimation	300
Properties of best estimator	301
Unbiased estimator	301
Consistent estimator.....	306
Efficient estimator	309
Sufficient estimator	312
Maximum likelihood parameter	315

Properties of maximum likelihood estimators	315
Method of moments	319
Properties of the moment method	319

Chapter 13

Theory of Testing a Hypothesis

A Statistical Hypothesis.....	324
Null Hypothesis	324
Composite Hypothesis	324
Critical Region and Acceptance Region	325
Type of errors	325
Level of significance	325
Power Function of a test	325
Best critical Region	326
Procedure for testing a hypothesis	326
Recurred relation	327

Chapter 14

Markov Analysis

Introduction.....	341
Stochastic process.....	341
Markov Process	341
Classification of Markov processes	342
Transition probability	342
Transition probability matrix	342
n-step Transition probabilities	342
Diagrammatic Representation of Transition probabilities	343
Multi-period Transition probabilities	344
First order and Higher order Markov Process	345
Markov chain	351

Steady state (Equilibrium) condition	353
Method for determining steady state condition	353
Characteristics of a Markov chain	358

Chapter 15

Queuing Theory

Introduction.....	362
Important definition in Queuing Theory	362
Queuing system	363
Transient and steady states	365
Traffic Intensity (Utilization factor)	366
Probability distributions in Queuing systems	366
Distribution of Arrival (Pure Birth Process)	367
Distribution of Inter-arrival times (Exponential Process)	370
Distribution of Departures (Pure Death Process)	371
Distribution of service Times	374
Concepts of Queuing Models	374
Solution of Queuing Models	374
Model II (M/M/I): (N/ ∞ /FCFS)	390
Measures of Model II	392
Model III (M/M/I): (∞/∞ /FCFS)	395
Measures for Model III	398

Chapter 16

Fuzzy Sets

Introduction	407
Fuzzy versus crisp	407
Fuzzy Sets	408
Power of a Fuzzy Set	412
Product of a Fuzzy with a crisp number	412

Properties of Fuzzy sets	413
Fuzzy Relations	414
Fuzzy Cartesian product	414
Composition of relations	415
Binary relations	417
Operations of Fuzzy relations	418
Fuzzy logic	419
Fuzzy proposition	419
Types of Fuzzy propositions	420
Fuzzy connectives	420
Fuzzy Quantifiers	423
Fuzzy Inference	423
Fuzzy Relation Equations	426
Defuzzification	431

Chapter 17

Decision Theory

Introduction	435
Basic concept of Decision Theory	435
Type of Decision making Environment	436
Decision making under uncertainty	436
Decision making under Risk.....	442

Chapter 18

Calculus of Variation

Introduction	456
Functionals	456
Euler's Equation	459
Functional dependent on more than one independent variable (Euler – Ostrogradsky equation)	469
Variation Problems in Parametric form (Euler Langrange equation)	472
Rayleigh – Ritz Method	483

Galerkin's method	490
Discretization	492
Finite element method	492
Variational formulation	492

Chapter 19

Theory of Reliability and Fault Tolerance

Introduction	496
Definition of Reliability	496
Failure rate (Hazard rate)	496
Reliability Functions	497
Properties of reliability	498
Mean time to Failure (MTTF)	498
Mean time between Failure (MTBF)	499
Relation between Reliability and mean Time between Failures	499
Maintainability	500
Availability	500
System Reliability	501
The Importance of fault Tolerance	512

Chapter 20

Goal Programming

Introduction	513
Goal Programming model formulation	513
Single goal models	514
Multiple goal models	515
The general goal programming model	516
Graphical solution of GP problems	516
Simplex method of GP.....	520

Chapter 21**MATLAB**

Introduction	527
Starting MATLAB.....	527
The MATLAB environment	528
Useful functions and operation in MATLAB	528
Obtaining help on MATLAB Commands.....	529

Chapter 22**Hankel and Mellin Transforms**

Hankel Transforms	558
Inversion Hankel Transform.....	558
Linear Property	560
Some useful results	560
Hankel Transform of the Derivatives	564
The Finite Hankel Transforms.....	565
Hankel Transform of $\frac{d^2f}{dx^2} + \frac{1}{x} \frac{df}{dx} - \frac{n^2}{x^2} f$	569
Applications of Hankel Transform	570
Mellin Transforms	578
Inversion Mellin Transform.....	578
Linear Property	579
Some Elementary Properties.....	579
Mellin Transform of Derivatives	581
Mellin Transform of Integrals.....	582
Convolution (or Falting) Theorem.....	585

Chapter 23**Integral Equation**

Introduction.....	578
Integral Equation	578
Integro Differential Equation.....	578
Linear Integral Equation	578
Volterra Integral Equation	579
Fredholm Integral Equation	579
Non-Linear Integral Equation.....	580
Singular Integral Equation.....	580
Convolution Integral	580
Solution of Integral Equation.....	581
Relation between Differential and Integral Equation	586
Solution of Volterra's Integral Equation of Second Kind by the Method of Successive Approximation.....	600
Determination of Some Resolvent Kernels.....	612
Solution of Fredholm Integral Equation of Second Kind by the Method of Successive Approximation.....	622
Integral Equation with Fredholm's Determinant	643
Integral Equation with Degenerate (Separable) Kernels.....	659
Construction of Green's Function.....	678
To Solve the Boundary Value Problem	691
Construction of Green's Function when the Boundary Value Problem contains a Parameter	696
Practice Problems.....	709