

CONTENTS

1 LOGIC

1.1	Representation of Thought	1
1.2	Elementary Concepts	2
1.3	Propositional Logic	5
1.3.1	Logical Variables and Connectives	5
1.3.2	Logical Expressions	11
1.3.3	Logical Normal Form	14
1.3.4	Logical Rules of Inference	18
1.4	Predicate Logic	20
1.5	Proofs and Axioms	26

2 SET THEORY

2.1	Sets	31
2.2	Algebra of Sets	34
2.3	Relations	37
2.4	Types of Relations	40
2.5	Mappings	44
2.6	Types of Mappings	46
2.7	Cardinality and Countability	51
2.8	Structures	56

3 ALGEBRAIC STRUCTURES

3.1	Introduction	59
3.2	Inner Operations	60
3.3	Sets with One Operation	63
3.4	Sets with Two Operations	68
3.4.1	Introduction	68
3.4.2	Additive and Multiplicative Domains	69
3.4.3	Dual Domains	76
3.5	Vector Spaces	86
3.5.1	General Vector Spaces	86
3.5.2	Real Vector Spaces	94
3.6	Linear Mappings	99
3.7	Vector and Matrix Algebra	109
3.7.1	Definitions	109
3.7.2	Elementary Vector Operations	112
3.7.3	Elementary Matrix Operations	116
3.7.4	Derived Scalars	123
3.7.5	Complex Vectors and Matrices	127

4 ORDINAL STRUCTURES

4.1	Introduction	131
4.2	Ordered Sets	132
4.3	Extreme Elements	138
4.4	Ordered Sets with Extremality Properties	141
4.5	Mappings of Ordered Sets	145
4.6	Properties of Ordered Sets	151
4.7	Ordered Cardinal Numbers	158

5 TOPOLOGICAL STRUCTURES

5.1	Introduction	161
5.2	Topological Spaces	163
5.3	Bases and Generating Sets	167
5.4	Metric Spaces	172
5.5	Point Sets in Topological Spaces	179
5.6	Topological Mappings	184
5.7	Construction of Topologies	189
5.7.1	Final and Initial Topologies	189
5.7.2	Subspaces	195
5.7.3	Product Spaces	199
5.8	Connectedness of Sets	201
5.8.1	Disconnections and Connectedness	201
5.8.2	Connectedness of Constructed Sets	207
5.8.3	Components and Paths	212
5.9	Separation Properties	219
5.10	Convergence	227
5.10.1	Convergence of Sequences	227
5.10.2	Subsequences	237
5.10.3	Series	241
5.10.4	Convergence of Nets	249
5.10.5	Convergence of Filters	255
5.11	Compactness	259
5.11.1	Compact Spaces	259
5.11.2	Compact Metric Spaces	268
5.11.3	Locally Compact Spaces	272
5.12	Continuity of Real Functions	276

6 NUMBER SYSTEM

6.1	Introduction	285
6.2	Natural Numbers	286
6.3	Integers	289
6.4	Rational Numbers	293
6.5	Real Numbers	296
6.6	Complex Numbers	303
6.7	Quaternions	307

7 GROUPS

7.1	Introduction	309
7.1.1	Group Theory	309
7.1.2	Outline	312
7.2	Groups and Subgroups	314
7.3	Types of Groups	319
7.3.1	Permutation Groups	320
7.3.2	Symmetry Groups	323
7.3.3	Generated Groups	327
7.3.4	Cyclic Groups	330
7.3.5	Groups of Integers	333
7.3.6	Cyclic Subgroups	338
7.4	Class Structure	342
7.4.1	Classes	342
7.4.2	Cosets and Normal Subgroups	344
7.4.3	Groups of Residue Classes	350
7.4.4	Conjugate Elements and Sets	352
7.5	Group Structure	357
7.5.1	Introduction	357
7.5.2	Homomorphism	359
7.5.3	Isomorphism	366
7.5.4	Isomorphic Types of Groups	373
7.5.5	Automorphisms	376
7.6	Abelian Groups	382
7.6.1	Introduction	382
7.6.2	Classification of Abelian Groups	383
7.6.3	Linear Combinations	388
7.6.4	Direct Sums	394

7.6.5	Constructions of Abelian Groups	402
7.6.6	Decompositions of Abelian Groups	411
7.7	Permutations	417
7.7.1	Introduction	417
7.7.2	Symmetric Groups	418
7.7.3	Cycles	422
7.7.4	Conjugate Permutations	428
7.7.5	Transpositions	431
7.7.6	Subgroups of a Symmetric Group	434
7.7.7	Group Structure of the Symmetric Group S_4	439
7.7.8	Class Structure of the Symmetric Group S_4	450
7.8	General Groups	455
7.8.1	Introduction	455
7.8.2	Classes in General Groups	456
7.8.3	Groups of Prime-power Order	464
7.8.4	Normal Series	473
7.9	Unique Decomposition of Abelian Groups	482
8	GRAPHS	
8.1	Introduction	489
8.2	Algebra of Relations	491
8.2.1	Introduction	491
8.2.2	Unary Relations	492
8.2.3	Homogeneous Binary Relations	496
8.2.4	Heterogeneous Binary Relations	504
8.2.5	Unary and Binary Relations	509
8.2.6	Closures	512
8.3	Classification of Graphs	517
8.3.1	Introduction	517
8.3.2	Directed Graphs	518
8.3.3	Bipartite Graphs	524
8.3.4	Multigraphs	530
8.3.5	Hypergraphs	535
8.4	Structure of Graphs	538
8.4.1	Introduction	538
8.4.2	Paths and Cycles in Directed Graphs	539
8.4.3	Connectedness of Directed Graphs	546

8.4.4	Cuts in Directed Graphs	552
8.4.5	Paths and Cycles in Simple Graphs	563
8.4.6	Connectedness of Simple Graphs	567
8.4.7	Cuts in Simple Graphs	569
8.4.8	Acyclic Graphs	574
8.4.9	Rooted Graphs and Rooted Trees	580
8.5	Paths in Networks	584
8.5.1	Introduction	584
8.5.2	Path Algebra	586
8.5.3	Boolean Path Algebra	600
8.5.4	Real Path Algebra	602
8.5.4.1	Minimal Path Length	602
8.5.4.2	Maximal Path Length	604
8.5.4.3	Maximal Path Reliability	606
8.5.4.4	Maximal Path Capacity	607
8.5.5	Literal Path Algebra	609
8.5.5.1	Path Edges	609
8.5.5.2	Common Path Edges	611
8.5.5.3	Simple Paths	613
8.5.5.4	Extreme Simple Paths	615
8.5.5.5	Literal Vertex Labels	616
8.5.5.6	Literal Edge Labels for Simple Graphs	619
8.5.5.7	Applications in Structural Analysis	620
8.5.6	Properties of Path Algebras	621
8.5.7	Systems of Equations	626
8.5.7.1	Solutions of Systems of Equations	626
8.5.7.2	Direct Methods of Solution	630
8.5.7.3	Iterative Methods of Solution	640
8.6	Network Flows	645
8.6.1	Introduction	645
8.6.2	Networks and Flows	647
8.6.3	Unrestricted Flow	649
8.6.4	Restricted Flow	653
8.6.5	Maximal Flow	657
8.6.6	Maximal Flow and Minimal Cost	662
8.6.7	Circulation	665

9	TENSORS	
9.1	Introduction	671
9.2	Vector Algebra	672
9.2.1	Vector Spaces	672
9.2.2	Bases	675
9.2.3	Coordinates	679
9.2.4	Metrics	682
9.2.5	Construction of Bases	686
9.2.6	Transformation of Bases	692
9.2.7	Orientation and Volume	700
9.3	Tensor Algebra	702
9.3.1	Introduction	702
9.3.2	Tensors	704
9.3.3	Transformation of Tensor Coordinates	710
9.3.4	Operations on Tensors	712
9.3.5	Antisymmetric Tensors	716
9.3.6	Tensors of First and Second Rank	730
9.3.7	Properties of Dyads	739
9.3.8	Tensor Mappings	752
9.4	Tensor Analysis	764
9.4.1	Introduction	764
9.4.2	Point Spaces	766
9.4.3	Rectilinear Coordinates	768
9.4.4	Derivatives with Respect to Global Coordinates	770
9.4.5	Curvilinear Coordinates	775
9.4.6	Christoffel Symbols	781
9.4.7	Derivatives with Respect to Local Coordinates	787
9.4.8	Tensor Integrals	796
9.4.9	Field Operations	806
9.4.10	Nabla Calculus	819
9.4.11	Special Vector Fields	825
9.4.12	Integral Theorems	829

10 STOCHASTICS

10.1	Introduction	841
10.2	Random Events	843
10.2.1	Introduction	843
10.2.2	Elementary Combinatorics	843
10.2.3	Algebra of Events	846
10.2.4	Probability	848
10.2.5	Reliability	853
10.3	Random Variables	858
10.3.1	Introduction	858
10.3.2	Probability Distributions	860
10.3.3	Moments	865
10.3.4	Functions of One Random Variable	868
10.3.5	Functions of Several Random Variables	872
10.3.6	Discrete Distributions	878
10.3.6.1	Bernoulli Distribution	878
10.3.6.2	Binomial Distribution	879
10.3.6.3	Pascal Distribution	881
10.3.6.4	Poisson Distribution	884
10.3.7	Continuous Distributions	887
10.3.7.1	Gamma Distribution	887
10.3.7.2	Normal Distribution	890
10.3.7.3	Logarithmic Normal Distribution	895
10.3.7.4	Maximum Distributions	898
10.3.7.5	Minimum Distributions	905
10.4	Random Vectors	906
10.4.1	Introduction	906
10.4.2	Probability Distributions	907
10.4.3	Moments	912
10.4.4	Functions of a Random Vector	916
10.4.5	Multinomial Distribution	918
10.4.6	Multinormal Distribution	920
10.5	Random Processes	922
10.5.1	Introduction	922
10.5.2	Finite Markov Processes in Discrete Time	926
10.5.2.1	Introduction	926
10.5.2.2	States and Transitions	926

10.5.2.3	Structural Analysis	932
10.5.2.4	Spectral Analysis	936
10.5.2.5	First Passage	940
10.5.2.6	Processes of Higher Order	948
10.5.3	Finite Markov Processes in Continuous Time	949
10.5.3.1	Introduction	949
10.5.3.2	States and Transition Rates	949
10.5.3.3	First Passage	954
10.5.3.4	Queues	959
10.5.3.5	Queue Systems	970
10.5.4	Stationary Processes	976
10.5.4.1	Introduction	976
10.5.4.2	Probability Distributions and Moments	976
10.5.4.3	Stationary Processes in Discrete Time	979
10.5.4.4	Stationary Processes in Continuous Time	986
Index	991

Mathematical Foundations of Computational
Engineering
A Handbook

Pahl, P.J.; Damrath, R.

2001, XXXVI, 1007 p. In 2 volumes, not available
separately., Hardcover

ISBN: 978-3-540-67995-0