LIST OF CONTENTS

Foreword		xiii
Biographical Sketches of the authors		xiv
Preface		xv
Acknowledgments		xix
List of Principal Symbols		xxi

PART I THEORETICAL CONCEPTS

1.	FUZZY SET THEORY AND SYSTEM MODELLING	3
	1.1 Modelling and System Theory	3
	1.2 Approximate Reasoning	4
	1.3 Fuzzy Set Theory	5
	1.4 Fuzzy Mathematical Modelling	5
	1.5 Examples	6
2.	THEORY OF FUZZY SETS	9
	2.1 Theory of Binary Sets	9
	2.2 Theory of Fuzzy Sets	13
3.	THEORY OF FUZZY NUMBERS	19
	3.1 Interval of Confidence	19
	3.2 Arithmetic Operations on Interval of Confidence and Fuzzy Numbers	22
	3.3 Triangular Fuzzy Numbers (T.F.N.'s)	26
	3.4 Trapezoidal Fuzzy Numbers (Tr.F.N.'s)	31
4.	LINEAR ORDERING OF FUZZY NUMBERS	37
5.	EVALUATION OF IMPRECISION IN FUZZY NUMBERS	45

6. TRIANGULAR APPROXIMATION OF VARIOUS FUNCTIONS OF TRIANGULAR FUZZY NUMBERS 55

7. DECONVOLUTION OF THE FUZZY EQUATIONS **A** (+) **B** = **C**, AND **A** (·) **B** = **C** IN R 69
- 7.1 Deconvolution of **A** (+) **B** = **C** with Intervals of Confidence in R 69
- 7.2 Deconvolution of A (·) $B = C$ with Interval of Confidence in R 70
- 7.3 Deconvolution of **A** (·) **B** = **C** with Fuzzy Numbers 84
- 7.4 Deconvolution of Fuzzy Equations of the type **A** (·) **B** $\subset$ **C** 92

8. T-NORMS AND T-CONORMS 95
- 8.1 Definition and Properties of T-Norms and T-Conorms 95
- 8.2 Generation of T-Norms and T-Conorms 103

9. FUZZY NUMBERS IN [0, 1] 113

10. FUZZY NUMBERS IN [0, 1] WITH HIGHER-ORDER INTERVALS OF CONFIDENCE IN [0, 1] 121
- 10.1 Higher-Order Intervals of Confidence 121
- 10.2 Simultaneous Equations with Equalities 126
- 10.3 Equations with Inequalities 131
- 10.4 Principle of Uncertainty Reduction 139

PART II MODELS IN ENGINEERING AND MANAGEMENT SCIENCE

11. MODELLING ISSUES IN ENGINEERING AND MANAGEMENT SCIENCE 143

12. FUZZY ZERO-BASE BUDGETING (F.Z.B.B.) 145

13. FUZZY DELPHI METHOD (F.D.M.) IN FORECASTING AND DECISION MAKING 151

14. DISCOUNTING PROBLEM USING FUZZY NUMBERS 159

15. SMOOTHING (FILTERING) OF FUZZY DATA 167
15.1 Smoothing of Non-Fuzzy Data 168
15.2 Smoothing of Fuzzy Data 171

16. RELIABILITY MODELLING AND EVALUATION WITH FUZZY DATA 177
16.1 Possibility Theory of Reliability 178
16.2 Reliability Evaluation Using Interval of Confidence 184
16.3 Classical Reliability Models 195
16.4 Possibility Theory in the Evaluation of Reliability Models 202

17. ORDERING OF FUZZY QUOTIENTS 209
17.1 Quotients with Intervals of Confidence 209
17.2 Quotients with α – cuts 212
17.3 Quotients with T.F.N.s 218

18. CRITICAL PATH METHOD (C.P.M.) WITH FUZZY DATA 221

19. INVESTMENT PROBLEM WITH FUZZY DATA 243

20. TRANSPORTATION OPTIMIZATION WITH FUZZY DATA: (FUZZY STEPPING STONE METHOD) 251
20.1 Stepping Stone Method with Ordinary Numbers 251
20.2 Stepping Stone Method with Fuzzy Numbers 258

21. A GENERAL VIEW ABOUT THE FUZZIFICATION OF MODELS IN ENGINEERING AND MANAGEMENT SCIENCE 269

BIBLIOGRAPHY FOR PART I 273

REFERENCES ON VARIOUS APPLICATIONS: PART II 275

APPENDIX A: ON SOME PROPERTIES OF T.F.N.s AND Tr.F.N.s 281

APPENDIX B: MINKOWSKI'S OPERATIONS ON ORDINARY SUBSETS 289

B.1 Minkowski's Sum 289
B.2 Minkowski's Subtraction 297
B.3 Minkowski's Solution of Equations 302

APPENDIX C: FUZZY QUANTITIES 313

APPENDIX D: MINKOWSKI'S OPERATIONS ON FUZZY QUANTITIES 315

APPENDIX E: A GENERAL BIBLIOGRAPHY 321

APPENDIX F: SELECTED BOOKS ON FUZZY SET THEORY AND APPLICATIONS 333

APPENDIX G: MAJOR CURRENT BIBLIOGRAPHICAL SOURCES ON FUZZY SETS AND SYSTEMS 337