- Preface p. xix
- Acknowledgements p. xxi
- Notation p. xxiii
- Chapter 1 An Introduction to Reliability and Risk Assessment p. 1
- 1.1 Introduction p. 1
- 1.2 Quantified reliability p. 2
- 1.3 Reliability terminology p. 3
- 1.4 Reliability programmes p. 6
- 1.5 Quantified risk assessment p. 7
- 1.6 Risk assessment studies p. 14
- 1.7 Reliability in risk assessment p. 16
- 1.8 Risk ranking p. 18
- 1.9 Summary p. 20
- 1.10 References p. 20
- Chapter 2 Reliability Mathematics p. 21
- 2.1 Probability theory p. 21
- 2.2 Set theory p. 44
- 2.3 Boolean algebra p. 51
- 2.4 Summary p. 57
- 2.5 Bibliography p. 58
- Chapter 3 Qualitative Methods p. 59
- 3.1 Introduction p. 59
- 3.2 Hazard analysis p. 59
- 3.3 Checklists p. 60
- 3.4 Hazard and operability studies p. 62
- 3.5 Rapid ranking p. 66
- 3.6 Preliminary hazard analysis p. 70
- 3.7 Reliability and maintainability screening p. 72
- 3.8 Summary p. 74
- 3.9 References p. 74
- Chapter 4 Failure Mode and Effects Analysis p. 75
- 4.1 Introduction p. 75
- 4.2 Procedure for performing an FMEA/FMECA p. 76
- 4.3 Criticality analysis p. 84
- 4.4 Functional and hardware FMEA/FMECA examples p. 88
- 4.5 Multi-criteria Pareto ranking p. 99
- 4.6 Common cause screening p. 100
- 4.7 Matrix method p. 101
- 4.8 Risk priority number method of FMECA p. 103
- 4.9 Fuzzy logic prioritization of failures p. 107
- 4.10 Generic parts count p. 111
- 4.11 Summary p. 113
- 4.12 References p. 113
- Chapter 5 Quantification of Component Failure Probabilities p. 115
- 5.1 Introduction p. 115
- 5.2 The failure process p. 119

- 5.3 The repair process p. 127
- 5.4 The whole failure/repair process p. 128
- 5.5 Calculating unconditional failure and repair intensities p. 133
- 5.6 Maintenance policies p. 140
- 5.7 Failure and repair distribution with non-constant hazard rates p. 143
- 5.8 Weibull analysis p. 149
- 5.9 Summary p. 163
- 5.10 References p. 164
- 5.11 Bibliography p. 164
- Chapter 6 Reliability Networks p. 165
- 6.1 Introduction p. 165
- 6.2 Simple network structures p. 167
- 6.3 Complex networks p. 179
- 6.4 Network failure modes p. 188
- 6.5 Network quantification p. 196
- 6.6 Summary p. 198
- 6.7 Bibliography p. 199
- Chapter 7 Fault Tree Analysis p. 201
- 7.1 The fault tree model p. 201
- 7.2 Examples of the use of fault tree symbols p. 206
- 7.3 Boolean representation of a fault tree p. 211
- 7.4 Component failure categories p. 211
- 7.5 Fault tree construction p. 212
- 7.6 Qualitative fault tree analysis p. 219
- 7.7 Fault tree quantification p. 228
- 7.8 Importance measures p. 254
- 7.9 Expected number of system failures as a bound for systems unreliability p. 265
- 7.10 Use of system performance measures p. 266
- 7.11 Benefits to be gained from fault tree analysis p. 266
- 7.12 Summary p. 267
- 7.13 Bibliography p. 267
- Chapter 8 Common Cause Failures p. 269
- 8.1 Introduction p. 269
- 8.2 Common mode and common cause failures p. 269
- 8.3 Other common cause failure models p. 275
- 8.4 Choice of CCF model p. 278
- 8.5 Fault tree analysis with CCF p. 281
- 8.6 Summary p. 284
- 8.7 References p. 285
- Chapter 9 Maintainability p. 287
- 9.1 Introduction p. 287
- 9.2 Maintainability analysis p. 287
- 9.3 The maintainability model p. 289
- 9.4 Maintainability prediction p. 290
- 9.5 MTTR synthesis p. 295
- 9.6 Summary p. 300

- 9.7 Reference p. 300
- Chapter 10 Markov Analysis p. 301
- 10.1 Introduction p. 301
- 10.2 Example--single-component failure/repair process p. 304
- 10.3 General Markov state transition model construction p. 308
- 10.4 Markov state equations p. 309
- 10.5 Dynamic solutions p. 312
- 10.6 Steady-state probabilities p. 313
- 10.7 Standby systems p. 316
- 10.8 Reduced Markov diagrams p. 320
- 10.9 General three-component system p. 323
- 10.10 Time duration in states p. 325
- 10.11 Transient solutions p. 332
- 10.12 Reliability modelling p. 337
- 10.13 Summary p. 340
- 10.14 Bibliography p. 340
- Chapter 11 Simulation p. 341
- 11.1 Introduction p. 341
- 11.2 Uniform random numbers p. 342
- 11.3 Direct simulation method p. 345
- 11.4 Dagger sampling p. 347
- 11.5 Generation of event times from distributions p. 349
- 11.6 System logic p. 354
- 11.7 System example p. 356
- 11.8 Terminating the simulation p. 359
- 11.9 Summary p. 360
- 11.10 Bibliography p. 361
- Chapter 12 Reliability Data Collection and Analysis p. 363
- 12.1 Introduction p. 363
- 12.2 Generic data p. 364
- 12.3 In-service reliability data p. 366
- 12.4 Data collection p. 368
- 12.5 Data quality assurance p. 375
- 12.6 Reliability data analysis p. 377
- 12.7 Generic reliability data analysis p. 398
- 12.8 Summary p. 411
- 12.9 References p. 412
- Chapter 13 Risk Assessment p. 413
- 13.1 Introduction p. 413
- 13.2 Background p. 413
- 13.3 Major accident hazards p. 415
- 13.4 Major accident hazard risk assessments p. 419
- 13.5 Risk-based inspection and maintenance p. 434
- 13.6 Summary p. 446
- 13.7 References p. 447

- Chapter 14 Case study 1 Quantitative safety assessment of the ventilation recirculation system in an undersea mine p. 449
- 14.1 Introduction p. 449
- 14.2 Recirculation fan system description p. 450
- 14.3 Conditions for fan stoppage p. 451
- 14.4 Scope of the analysis p. 452
- 14.5 System description p. 453
- 14.6 Fault tree construction p. 456
- 14.7 Qualitative fault tree analysis of the system p. 458
- 14.8 Component failure and repair data p. 462
- 14.9 Quantitative system analysis p. 465
- 14.10 Performance of the methane and carbon monoxide monitoring systems p. 467
- 14.11 Variations in system design and operation p. 468
- 14.12 Conclusions p. 474
- Chapter 14 Case study 2 Failure mode and effects criticality analysis of gas turbine system p. 475
- 14.13 Introduction p. 475
- 14.14 Gas turbine FMECA p. 475
- 14.15 Discussion p. 486
- 14.16 Summary p. 487
- Chapter 14 Case study 3 In-service inspection of structural components (application to conditional maintenance of steam generators) p. 489
- 14.17 Introduction p. 489
- 14.18 Data needed for safety and maintenance objectives p. 491
- 14.19 The steam generator maintenance programme p. 493
- 14.20 Expected benefits of the probabilistic ISI base programme p. 493
- 14.21 Data for safety and data for maintenance p. 495
- 14.22 The probabilistic fracture mechanics model p. 497
- 14.23 Safety and maintenance-orientated results p. 500
- 14.24 Sensitivity analysis p. 503
- 14.25 Conclusions p. 506
- Chapter 14 Case study 4 Business-interruption risk analysis p. 507
- 14.26 Introduction p. 507
- 14.27 Risk assessment p. 508
- 14.28 Combined-cycle plant assessment p. 509
- 14.29 Data and basic assumptions p. 510
- 14.30 Plant availability prediction p. 512
- 14.31 Risk estimation p. 516
- 14.32 Conclusions p. 519
- 14.33 References p. 520
- Appendix A p. 523
- Appendix B p. 527
- Glossary p. 529
- Index p. 535