

# Contents

<b>Introduction .....</b>	<b>9</b>
<b>1. General issues of technical systems reliability.....</b>	<b>11</b>
1.1. Technical systems reliability basics as the science .....	11
1.2. The primary concepts, terminology and definitions of reliability basics .....	14
1.3. The reliability theory mathematical apparatus.....	19
1.3.1. The reliability theory axioms .....	21
1.3.2. Direct and inverse tasks of reliability .....	22
1.3.3. System design stage .....	25
1.3.4. Stage of production and testing of prototypes, modules and subsystems ...	37
1.3.5. Stage of batch sample production, certification and transmission into operation .....	37
1.3.6. Reliability during operation stage .....	38
1.3.7. The final stage of a system life cycle .....	39
1.4. Major reliability characteristics .....	39
1.4.1. Reliability characteristics of non-renewable objects .....	41
1.4.2. Reliability characteristics of renewable facilities .....	48
REFERENCES .....	53
<b>2. The information system as an object of reliability research .....</b>	<b>55</b>
2.1. General information about information systems .....	55
2.2. Information security systems operation analysis's the object's reliability research .....	64
2.2.1. Problems of information security .....	64
2.2.2. Threats and safety measures for information protection .....	67
2.3. Reliability characteristics classification .....	75
2.4. Information signals at the system reliability characteristics identification.....	77
2.4.1. Classification of information signals .....	81
2.4.2. Baseline signals at the information systems reliability characteristics identification .....	84
2.5. Reliability problems stochastic processes modeling .....	84
2.5.1. Modeling of pseudorandom numbers sequences .....	85
2.5.2. Modeling of random processes typical sequences .....	86
2.6. Characteristics of information systems reliability as of the hardware-software system .....	89
REFERENCES .....	91

<b>3. Factors affecting the information systems reliability and failures .....</b>	<b>92</b>
3.1. General classification of factors .....	92
3.2. Climatic factors .....	93
3.2.1. Characteristics of climatic factors influence .....	93
3.2.2. Hardware protecting from climatic influences .....	98
3.3. Electrical, electromagnetic and radiation factors .....	99
3.4. Shock-vibration factors .....	100
3.4.1. Characteristics of vibration factors .....	101
3.4.2. The effects of mechanical stresses .....	102
3.4.3. Protecting equipment from exposure to mechanical stress.....	103
3.5. Factors affecting the reliability of software .....	103
3.6. Sources of formation and failure modes of systems .....	106
3.7. Classification of failures .....	108
3.8. Examples of failure flows models.....	113
3.9. Illustrative graphic schemes of system failure formation.....	116
3.10. Examples of phasing failure typical models .....	117
3.11. Modeling of sudden failures based on the exponential law .....	121
REFERENCES .....	123
<b>4. Backup of information systems .....</b>	<b>125</b>
4.1. Typical structures of systems .....	125
4.2. Types of system backup .....	129
4.3. Continuous backup of system elements.....	131
4.4. Substitutional backup.....	132
4.5. Facilitated reserve .....	134
4.6. Reservation with restoration .....	135
4.7. Partial redundancy (system $k$ with $n$ ).....	141
4.8. Majoritarian redundancy .....	141
4.9. Converting the block diagramby an equivalent replacement of triangle into star .....	142
4.10. General and separate reservation .....	143
4.11. Training of elements and systems .....	145
REFERENCES .....	150
<b>5. Information systems reliability characteristics definition .....</b>	<b>152</b>
5.1. Methodology and problems of reliability characteristics determination .....	152
5.2. Calculative characteristics of system reliability .....	153
5.3. Statistically based system reliability characteristics .....	155
5.4. Characteristics of systems longevity.....	159
5.4.1. Example of disability of a system for a given period of its continuous operation .....	159
5.4.2. The system work efficiency loss till failure .....	164
REFERENCES .....	167
<b>6. Information systems reliability testing .....</b>	<b>168</b>
6.1. Briefly about objects testing on reliability .....	168
6.2. Existing schedules for the objects reliability testing .....	170

6.3.	Laboratory tests of objects reliability .....	173
6.4.	Accelerated testing of objects on reliability .....	174
6.4.1.	Practical guidelines at the accelerated tests conducting .....	176
6.5.	Tests measurement data organization, registration and pre-processing .....	178
6.5.1.	Preliminary analysis of the test data .....	180
6.6.	Typical errors at the test organization, registration and initial test data statistical analysis .....	184
6.7.	Fundamentals of objects reliability testing measurement characteristics .....	185
6.7.1.	Selected provisions from the law of Ukraine “On Metrology and Metrological Activity” for the objects tested for reliability .....	186
6.7.2.	Measurement methods theory in the problems of reliability characteristics quantifying .....	187
	REFERENCES .....	196
<b>7.</b>	<b>Problem of software reliability .....</b>	<b>197</b>
7.1.	Process of software for information systems creation .....	197
7.2.	Reliability of information systems software .....	199
7.3.	Use of fail-safe programs.....	201
7.4.	Estimation of software reliability according the results of adjusting and normal operation .....	204
	REFERENCES .....	209
<b>8.</b>	<b>Maintenance of information system .....</b>	<b>211</b>
8.1.	General issue .....	211
8.2.	Preventative maintenance .....	212
8.3.	System repair and operation control .....	216
	REFERENCES .....	221
<b>9.</b>	<b>Information systems reliability forecasting and ensuring .....</b>	<b>223</b>
9.1.	Reliability characteristics prognosis problem formulation .....	223
9.2.	Reliability prognosis, based on the system operation determinant characteristic dynamics analysis .....	224
9.3.	System residual time to failure prediction .....	228
9.3.1.	Determination of residual lifetime based on diffusion monotone distribution .....	231
9.3.2.	Determination of the residual lifetime based on diffused monotonic distribution .....	232
9.4.	Methods of systems reliability scientific and technical problem solving .....	233
9.4.1.	Principal methods of system reliability analysis .....	234
9.4.2.	Program to ensure system reliability .....	235
9.4.3.	Requirements for safety during testing and operation .....	237
9.5.	Information systems reliability future research directions .....	239
	REFERENCES .....	241
<b>Glossary</b> .....		<b>243</b>