

# CONTENTS

<b>Preface</b> . . . . .	vii
<b>1 Environmental processes, their measurement and recording</b> . . . . .	<b>i</b>
1.1 Choice of measuring conditions and measured locations . . . . .	3
1.2 Recording of measured processes . . . . .	6
1.2.1 Organization of a measuring chain . . . . .	6
1.2.2 Organization of a tape record . . . . .	18
1.2.3 Organization of the measurement . . . . .	20
<b>2 Evaluation of random process properties.</b> . . . . .	<b>22</b>
2.1 Random process sampling . . . . .	25
2.2 Evaluation of occurrences of characteristic parameters . . . . .	29
2.2.1 The relative peak method. . . . .	29
2.2.2 The maximum amplitude method . . . . .	30
2.2.3 The method of the correlation table of extremes. . . . .	31
2.2.4 The relative range method . . . . .	34
2.2.5 The relative range and mean method. . . . .	36
2.2.6 The relative range, mean and frequency methods . . . . .	37
2.2.7 The rain flow method . . . . .	39
2.2.8 The level-crossing method . . . . .	41
2.2.9 The transition probability densities method . . . . .	42
2.2.10 Statistical relations between parameter occurrences. . . . .	50
2.3 Evaluation of processes as continuous random quantities . . . . .	52
2.3.1 Tests for stationarity. . . . .	53
2.3.2 Evaluation of properties of stationary processes . . . . .	58
2.3.2.1 Test for randomness. . . . .	58
2.3.2.2 Evaluation of one-dimensional probability density. . . . .	61
2.3.2.3 Test for normality. . . . .	63
2.3.2.4 Evaluation of the autocorrelation function . . . . .	66
2.3.2.5 Evaluation of the power spectral density . . . . .	69
2.3.2.6 Tests of difference and equivalence of statistical characteristics . . . . .	76
2.3.2.7 Confidence intervals for statistical characteristics . . . . .	81

2.3.3	Evaluation of properties of non-stationary processes . . . . .	83
2.4	Evaluation of processes as time series . . . . .	89
<b>3</b>	<b>Simulation of random processes . . . . .</b>	<b>97</b>
3.1	Generation of random numbers with a given distribution . . . . .	103
3.2	Simulation of a random process by sinusoidal cycles . . . . .	108
3.3	Simulation of a random process by sinusoidal half cycles . . . . .	112
3.4	Simulation of transitions between ordinates . . . . .	115
3.5	Simulation of local process extremes (envelopes) . . . . .	117
3.6	Simulation of the statistical characteristics of random processes . . . . .	121
3.6.1	Simulation of an arbitrarily distributed white noise . . . . .	125
3.6.2	Simulation of a Gaussian random process power spectral density (auto- correlation function) . . . . .	145
3.6.2.1	Harmonic analysis of random functions . . . . .	145
3.6.2.2	Solution of differential equations . . . . .	150
3.6.2.3	Method of moving summations and method of recurrent difference equations . . . . .	152
3.6.3	Simulation of power spectral density (autocorrelation function) of an arbitrarily distributed random process . . . . .	162
3.7	Simulation of non-stationary random processes . . . . .	168
3.7.1	Simulation of power . . . . .	168
3.7.2	Simulation of an autocorrelation function . . . . .	171
3.7.3	Simulation of non-stationary Markov processes . . . . .	181
3.7.4	Simulation of a time series . . . . .	187
3.7.5	Simulation of non-stationary processes with a stepwise variable auto- correlation . . . . .	204
3.7.6	Simulation of stable non-stationary random processes . . . . .	213
<b>4</b>	<b>Conclusions . . . . .</b>	<b>225</b>
	<b>References . . . . .</b>	<b>230</b>
	<b>Subject index . . . . .</b>	<b>232</b>