
Contents

1	Introduction	1
	References	5
2	Mathematical Preliminaries	7
2.1	Moments and Cumulants of Random Variables	7
2.2	Gaussian and Non-Gaussian Distributions	9
2.3	Moments and Cumulants of Stochastic Processes	11
2.4	Second-Order Stochastic Processes	13
2.5	Gaussian and Non-Gaussian Processes	20
2.6	Markov Processes	23
2.7	Diffusion Processes and Kolmogorov Equations	25
2.8	Wiener Process	27
2.9	White and Colored Noise	29
2.10	Integration and Differentiation Formulas of Diffusion Processes	31
2.11	Stochastic Differential Equations	35
2.12	Stochastic Stability	43
2.13	The Method of Fokker–Planck–Kolmogorov Equations	48
	Bibliography Notes	55
	References	56
3	Moment Equations for Linear Stochastic Dynamic Systems (LSDS)	59
3.1	Gaussian White Noise External Excitation	60
3.2	Gaussian White Noise External and Parametric Excitation ...	61
3.3	Gaussian Colored Noise External and Parametric Excitation ..	63
3.4	Nonstationary Gaussian External Excitation	65
3.5	Spectral Method	69
3.6	Non-Gaussian External Excitation	74
	Bibliography Notes	79
	References	80

4	Moment Equations for Nonlinear Stochastic Dynamic Systems (NSDS)	85
4.1	Moment Equations for Polynomial SDS Under Parametric and External Gaussian Excitation	86
4.2	Simple Closure Techniques	94
4.3	Non-Gaussian Closure Techniques	96
	Bibliography Notes	100
	References	100
5	Statistical Linearization of Stochastic Dynamic Systems Under External Excitations	103
5.1	Moment Criteria	103
5.2	Criteria in Probability Density Functions Space	118
5.3	Stationary Gaussian Excitations	123
5.4	Nonstationary Gaussian Excitations	125
5.5	Non-Gaussian Excitations	132
	Bibliography Notes	137
	References	142
6	Equivalent Linearization of Stochastic Dynamic Systems Under External Excitation	147
6.1	Introduction	147
6.2	Moment Criteria	147
6.3	Criteria in Probability Density Space	167
6.4	Criteria in Spectral Density Space	174
6.5	Multi-criterial Linearization Methods	187
6.6	Special Linearization Methods	195
	Bibliography Notes	201
	References	204
7	Nonlinearization Methods	211
7.1	Introduction	211
7.2	Moment Criteria	214
7.3	Probability Density Criteria	226
7.4	Application of the Generalized Stationary Potential Approach	229
7.5	Application of Stochastic Averaging Approach	235
7.6	Application of Volterra Functional Series Approach	240
	Bibliography Notes	246
	References	247
8	Linearization of Dynamic Systems with Stochastic Parametric Excitations	251
8.1	Introduction	251
8.2	Statistical Linearization	251
8.3	Equivalent Linearization	258
	Bibliography Notes	278
	References	279

9 Applications of Linearization Methods in Vibration

Analysis of Stochastic Mechanical Structures 281

9.1 Introduction 281

9.2 Applications in Hysteretic Systems 282

9.3 Vibrations of Structures
under Earthquake Excitations 293

9.4 Vibrations of Structures Under Wave Excitations 304

9.5 Vibrations of Structures Under Wind Excitations 307

9.6 Applications in Control Problems 308

Bibliography Notes 328

References 335

10 Accuracy of Linearization Methods 341

10.1 Theoretical Study of the Accuracy of Linearization Methods . . 341

10.2 Comparison of Linearized and Exact Response Characteristics 353

10.3 Comparison of Linearized and Simulated Response
Characteristics 356

10.4 Validation of Linearization Method by Experiments 359

10.5 Limitations of Applicability of Linearization Methods 365

Bibliography Notes 367

References 370

Index 377

