

Contents

<i>Preface</i>	vii
1. Deterministic and random oscillators	1
1.1 Simple harmonic oscillator	1
1.2 Damped harmonic oscillator	2
1.3 Driven harmonic oscillator	2
1.4 Driven, damped harmonic oscillator	3
1.5 Nonlinear oscillator in a double-well potential	3
1.6 Nonlinear oscillator in a single-well potential	4
1.7 Harmonic oscillator with external noise	4
1.8 Brownian motion	4
1.9 Harmonic oscillator with random frequency	5
1.10 Harmonic oscillator with random damping	6
2. White and colored noise	7
2.1 Dichotomous noise	8
2.2 White Poisson noise	9
2.3 Shot noise	9
3. Brownian motion	11
3.1 In the beginning...	11
3.2 Fokker-Planck equation	13
3.2.1 Additive white noise	13
3.2.2 Multiplicative white noise	15

3.2.3	Colored noise: unified colored noise approximation (UCNA)	18
3.3	Brownian motion and anomalous diffusion	19
3.4	Brownian motion near the critical point	21
4.	Overdamped harmonic oscillator with additive noise	25
4.1	Additive white noise	26
4.2	Additive noise and periodic force	27
5.	Overdamped harmonic oscillator with multiplicative noise	29
5.1	Multiplicative noise (shift of stable points)	29
5.2	Multiplicative and additive noises	30
5.2.1	Two white noises	31
5.2.2	Two correlated white noises	31
5.2.3	Two color dichotomous correlated noises	32
5.3	Multiplicative color noise and periodic signal (stochastic resonance (SR))	33
5.4	Stochastic resonance in a overdamped system with signal-modulated noise	37
6.	Overdamped single-well oscillator	41
6.1	Steady state	42
6.1.1	White noises	42
6.1.2	Multiplicative noise (gene selection)	44
6.1.3	Dichotomous noise	45
6.1.4	Poisson white noise	46
6.2	Response to a periodic force (noise-enhanced stability)	47
6.3	Piece-wise model of a metastable state	51
6.4	Rectangular potential barrier (stabilization of metastable state)	54
7.	Overdamped double-well oscillator	63
7.1	Steady state	64
7.1.1	White noise	64
7.1.2	Dichotomous noise	66

7.2	Eigenfunction expansion of the Fokker-Planck equation	67
7.3	Matrix continued fraction method	68
7.4	Mean first-passage time	71
7.5	Response to a periodic force (stochastic resonance)	73
7.6	Fluctuating potential barrier (resonance activation)	78
7.6.1	Piece-wise linear potential	79
7.6.2	Phenomenological model	81
7.6.3	Coherent stochastic resonance	82
8.	Harmonic oscillator with additive noise	83
8.1	Internal and external noise	83
8.2	White and dichotomous noise	84
8.3	Additive noise and parametric oscillations	86
9.	Nonlinear oscillator with additive noise	89
9.1	Statistical linearization	89
9.2	Double-well oscillator with additive noise	91
9.3	Double-well oscillator driven by two periodic fields (vibrational resonance)	92
10.	Harmonic oscillator with random frequency	97
10.1	First moment for the random frequency	97
10.1.1	Force-free oscillator	97
10.1.2	White noise	97
10.1.3	Colored noise	97
10.2	Driven oscillator	99
10.3	Second moment for a random frequency	102
10.4	Maxwell equation with random dielectric constant	104
10.4.1	Driven Maxwell equation	107
11.	Harmonic oscillator with random damping	109
11.1	First moment for random damping	109

11.1.1	Force-free oscillator	109
11.1.2	Driven oscillator	112
11.2	Second moment for random damping	116
11.3	Force-free oscillator	120
11.3.1	White noise	120
11.3.2	Dichotomous noise	120
11.4	Driven oscillator	120
11.5	Second moments	121
11.6	Correlation functions	122
11.7	Periodically varying damping	123
12.	Nonlinear oscillator with multiplicative noise	125
12.1	Double-well potential (noise induced reentrant transition)	125
12.2	Duffing oscillator	129
12.3	Van der Pol oscillator	130
13.	In the future ...	133
	<i>Bibliography</i>	135
	<i>Index</i>	143