

CONTENTS

PREFACE	vii
PART I DISSIPATIVE SYSTEMS	1
1. Introduction	2
2. Nonlinearity	10
3. Period Doubling to Chaos	16
4. Lyapunov Exponent	21
5. Power Spectra	28
6. Correlations	32
7. Remarks	35
8. Feigenbaum Universality	37
9. Feigenbaum Universality: Outline of Exact Renormalization Theory	44
10. Remarks on Experimental Observations	50
11. The Duffing Oscillator	58
12. Period Doubling to Chaos in a CO ₂ Laser Experiment	70
13. Bifurcations	73
14. The Intermittency (Pomeau-Manneville) Route to Chaos	73
15. From Quasiperiodicity to Chaos: The Ruelle-Takens-Newhouse Scenario	83
16. Remarks	90
17. Strange Attractors, Dimensions, and Fractals	92
18. Measuring Lyapunov Exponents	98
19. Measuring Dimensions	103
20. Kolmogorov Entropy	106
21. Noise	109
22. Maxwell-Bloch Equations	117
23. The Lorenz Model and the Single-Mode Laser	123
24. Single-Mode Instabilities: Homogeneous Broadening	139
25. Mode Splitting	146
26. Inhomogeneous Broadening: Chaos Associated with the Casperson Instability	150

27.	Inhomogeneous Broadening: Experiments	160
28.	Multimode Instabilities	162
29.	Physical Explanations of Self-Pulsing Instabilities	167
30.	Transverse Mode Effects	171
31.	Discussion	172
32.	More Laser Instabilities	174
33.	Optical Bistability	183
34.	Chaos in Optical Bistability	189
PART II HAMILTONIAN SYSTEMS		197
35.	Classical Hamiltonian Systems	198
36.	Integrability and Action-Angle Variables	206
37.	Integrability, Invariant Tori, and Quasiperiodicity	213
38.	Ergodicity, Mixing, and Chaos	214
39.	The Fermi-Pasta-Ulam Model	222
40.	The KAM Theorem	228
41.	Overlapping Resonances	230
42.	The Hénon-Heiles Model	241
43.	Remarks	246
44.	Characterization of Chaotic Behavior	250
45.	Is Classical Physics Really Deterministic?	252
46.	The Kicked Pendulum and the Standard Mapping	256
47.	Chaos in a Classical Model of Multiple-Photon Excitation of Molecular Vibrations	264
48.	Chaos in a Classical Model of a Rotating Molecule in a Laser Field	279
49.	Stochastic Excitation	285
50.	Quantum Chaos	293
51.	Regular and Irregular Spectra	299
52.	The Kicked Two-State System	307
53.	Chaos in the Jaynes-Cummings Model	318
54.	Quantum Theory of the Kicked Pendulum	330
55.	Localization	336

56.	Classical and Quantum Calculations for a Hydrogen Atom in a Microwave Field	343
57.	Epilogue	356
	REFERENCES	358