

Contents

Preface	v
Chapter 1. Cauchy Problem	1
1.1 Fundamental Theorems	1
1.2 Method of Euler Polygons	15
1.3 Local Behavior of Integral Curves	20
1.4 Peano Phenomenon	24
1.5 Convergence Theorem on Difference Methods	33
Chapter 2. Global Behavior of Solution	47
2.1 Global Existence of Solution	47
2.2 Predictability of Solution	58
2.3 Liapunov Stability	61
2.4 Liapunov Unstability	71
Chapter 3. Autonomous Systems	73
3.1 Phase Portrait	73
3.2 Orbital Box	76
3.3 Types of Orbits	77
3.4 Singular Points	79
3.5 General Property of Singular Points	86
3.6 Closed Orbit	87
3.7 Invariant Torus	91
3.8 Limit-Point Set	95
3.9 Poincaré-Bendixson Theorem	97

Chapter 4. Non-Autonomous Systems	101
4.1 General Systems	101
4.2 Conservative Systems	104
4.3 Dissipative Systems	106
4.4 Planar Periodic Systems	115
4.5 Invariant Continuum	119
Chapter 5. Dynamical Systems	123
5.1 The Originality	123
5.2 Recurrence	128
5.3 Quasi-Minimal Set	132
5.4 Minimal Set	134
5.5 Almost Periodic Motion	144
Chapter 6. Fixed-Point Theorems	155
6.1 Poincaré Index	155
6.2 Vector Fields on Closed Surfaces	165
6.3 Spatial Vector Fields	172
6.4 Fixed-Point Theorems of Brouwer Type	176
Chapter 7. Bend-Twist Theorem	181
7.1 Generalized Poincaré-Birkhoff Twist Theorem	181
7.2 Analytic Bend-Twist Theorem	184
7.3 Analytic Poincaré-Birkhoff Twist Theorem	189
7.4 Application of the Bend-Twist Theorem	191
Chapter 8. Chaotic Motions	199
8.1 Definition of Chaotic Motion	199
8.2 Chaotic Quasi-Minimal Set	201
8.3 Sufficient Conditions for Chaotic Sets	202
8.4 Chaotic Closed Surfaces	205
8.5 Applications	209
Chapter 9. Perturbation Method	217
9.1 Nonlinear Differential Equation of Second Order	217
9.2 Method of Averaging	225
9.3 High Frequency Forced Oscillations	230

Chapter 10. Duffing Equations of Second Order	241
10.1 Periodic Oscillations	241
10.2 Time-Map	250
10.3 Duffing Equation of Super-Linear Type	261
10.4 Duffing Equation of Sub-Linear Type	275
10.5 Duffing Equation of Semi-Linear Type	288
Chapter 11. Some Special Problems	313
11.1 Reeb's Problem	313
11.2 Birkhoff's Conjecture	319
11.3 Morse's Conjecture	326
11.4 Kolmogorov's Problem	331
11.5 Brillouin Focusing System	345
11.6 A Retarded Equation	355
11.7 Periodic Lotka-Volterra System	365
Bibliography	377