

Kenneth R. Meyer

Periodic Solutions of the N-Body Problem



Springer

Contents

1. Introduction	1
1.1 History	1
1.2 Global vs. Local Notation	4
1.3 Summary of Chapters	6
1.4 Further Reading	8
2. Equations of Celestial Mechanics	9
2.1 <i>N</i> -Body Problem	9
2.2 The Kepler Problem	11
2.3 Restricted Problem	12
2.4 Hill's Lunar Equations	16
2.5 Elliptic Problem	17
2.6 Problems	17
3. Hamiltonian Systems	19
3.1 Hamiltonian Systems	19
3.2 Symplectic Coordinates	20
3.3 Generating Functions	22
3.4 Rotating Coordinates	24
3.5 Jacobi Coordinates	25
3.6 Action-Angle and Polar Coordinates	30
3.7 Solution of the Kepler Problem	31
3.8 Spherical Coordinates	34
3.9 Symplectic Scaling	36
3.10 Problems	37
4. Central Configurations	39
4.1 Equilibrium Solutions	39
4.2 Equations for a Central Configuration	39
4.3 Relative Equilibrium	41
4.4 Lagrangian Solutions	42
4.5 Euler-Moulton Solutions	43
4.6 Central Configuration Coordinates	45
4.7 Problems	49

5. Symmetries, Integrals, and Reduction	51
5.1 Group Actions and Symmetries	53
5.2 Systems with Integrals	60
5.3 Noether's Theorem	61
5.4 Integrals	63
5.5 Symplectic Reduction	64
5.6 Reducing the N -Body Problem	66
5.7 Problems	70
6. Theory of Periodic Solutions	71
6.1 Equilibrium Points	71
6.2 Fixed Points	73
6.3 Periodic Differential Equations	75
6.4 Autonomous Systems	76
6.5 Systems with Integrals	79
6.6 Systems with Symmetries	83
6.7 Hamiltonian Systems with Symmetries	85
6.8 Problems	85
7. Satellite Orbits	87
7.1 Main Problem for Satellite Problem	87
7.2 Continuation of Solutions	89
7.3 Problems	90
8. The Restricted Problem	91
8.1 Main Problem for the Three-Bodies	92
8.2 Continuation of Periodic Solutions	96
8.3 Bifurcations of Periodic Solutions	98
8.4 Main Problem for $(N + 1)$ -Bodies	100
8.5 Reduction	101
8.6 Continuation of Periodic Solutions	102
8.7 Problems	102
9. Lunar Orbits	105
9.1 Main Problem	105
9.2 Continuation	107
9.3 Problems	110
10. Comet Orbits	111
10.1 Jacobi Coordinates and Scaling	111
10.2 Kepler Problem	112
10.3 Main Problem	113
10.4 Reduced Space	115
10.5 Continuation	116
10.6 Problems	117

11. Hill's Lunar Equations	119
11.1 Main Problem	120
11.2 Continuation	125
11.3 Problems	126
12. The Elliptic Problem	129
12.1 Apollonius Coordinates	130
12.2 Relative Equilibrium	132
12.3 Main Problem	133
12.4 Symmetries and Reduction	135
12.5 Continuation	136
12.6 Problems	137
References	138
Index	143