
Contents

Preface	ix
0 General Introduction	1
1 Lagrangian Mechanics	21
1 Lagrangian Systems	21
2 Ignorable Coordinates	22
3 Separable Systems	24
4 Liouville Systems	26
2 The Kepler Problem	29
1 Features of the Ellipse: Geometry and Analysis	29
2 The Two-Body Problem	33
3 The Kepler Problem: Vectorial Treatment	35
4 The Kepler Problem: Lagrangian Analysis	41
3 The Euler Problem I — Planar Case	49
1 The Gravitational Field of Two Fixed Centers: Planar Case	49
2 The Lagrangian in Liouville Form: The Energy Integral	51
3 The First Integrals in Liouville Coordinates	53
4 The First Integrals in Spheroidal Coordinates	54
5 Reduction of the Equations: The Regularizing Variable	56
6 Some Particular Cases	58
7 Analysis of the Generic Equation	62
8 The Equation for $S = \cos \sigma$: Specification of Λ	65
9 The Equation for R	77
10 The Time-Angle Relation	88
11 The Complementary Range	93
12 The Singular Case: $C = 0$	98
13 Summary of the Orbit Solutions	105
4 The Euler Problem II — Three-dimensional Case	113
1 The Gravitational Field of Two Fixed Centers: General Case	113
2 The Ignorable Coordinate: Liouville's Form and the Energy Integral	115

3	The First Integrals in Liouville Coordinates	118
4	The First Integrals in Spheroidal Coordinates	119
5	Reduction of Equations: The Regularization	120
6	Normalization of the Quartics	121
7	The σ -equation in the Case $\beta = 0$	123
8	The R -equation	125
9	The Integration of the Third (Longitude) Coordinate	133
10	The Time-Angle Relation	142
5	The Earth Satellite — General Analysis	143
1	The Geopotential and the Density Distribution	143
2	The Vinti Potential	147
3	The Vinti Dynamical Problem	150
4	The Integration of the Lagrangian Equations	153
5	Reduction of the Equations; Regularization; Normalization	155
6	The σ -Equation: Definition of Λ	157
7	The R -Equation	159
8	The Integration of the φ -Coordinate	172
9	The Time-Angle Relation	182
6	The Earth Satellite — Some Special Orbits	193
1	Orbits in the Near Equatorial Band	193
2	The Equatorial Orbit	196
3	The Polar Orbit	199
4	The “Critical” Inclination	205
Appendix: Calculation and Exhibition of Orbits;		
The Time-Angle Relation		211
1	Orbits in Chapter 3	213
2	Orbits in Chapters 5 and 6	214
3	The Time-Angle Relation	215
4	Orbits Derived from Given Initial Conditions in Chapter 3	216
References		227
Index		231



<http://www.springer.com/978-0-8176-4096-5>

Integrable Systems in Celestial Mechanics

Ó'Mathúna, D.

2008, X, 234 p. 24 illus., Hardcover

ISBN: 978-0-8176-4096-5

A product of Birkhäuser Basel