Classical Physics

Ikhan Choi

August 26, 2022

Contents

Part I

Mechanics

Chapter 1

Newtonian mechanics

1.1 Laws of motion

1.1 (Galilean structure).

1.2 (Galilean group).

1.3 (Conservation laws).

1.2 Oscillation

1.4 (Harmonic oscillator).

1.5 (Damped oscillation).

1.6 (Pendulum).

1.7 (Lissajous curve).

1.8 (Coupled oscillation).

1.3 Central forces

1.9 (Polar coordinates).

1.10 (Effective potential).

1.11 (Kepler's problem).

1.12 (Rutherford scattering).

1.4 System of particles

1.13 (Closed systems).

1.14 (Collisions).

1.15 (Two-body problem).

1.16 (Three-body problem).

Exercises

method of similarity (scaling)

Chapter 2

Lagrangian mechanics

2.1 Calculus of variations

2.1 (Euler-Lagrange equation).

2.2 (Closed system). $\frac{\partial \mathcal{L}}{\partial t} = 0$

2.3 (Definition of generalized momentum). $\frac{\partial \mathcal{L}}{\partial q} = 0$

2.4 (Equivalence to Newtonian mechanics).

2.2 Rigid bodies

2.5 (Inertia tensor).

2.6 (Eulerian angle).

2.7 (Lagrangian top).

Exercises

2.8 (Brachiostochrone).

2.9 (Geodesic on the sphere).

2.10 (Dido's isoperimetric problem).

2.11 (Pendulum with moving support). A rhenomic system

2.12 (Sliding beads on a rim).

2.13 (Double pulley system).

Chapter 3

Hamiltonian mechanics

Exercises

Part II

Chapter 4

Thermodynamics

Laws of thermodynamics Equation of states Maxwell's relations Thermal processes

Chapter 5

Kinetic theory

ergodic hypothesis Boltzmann statistics Boltzmann equation, chapman enskog BBGKY hierarchy stochastic processes linear response

Chapter 6

Continuum mechanics

6.1   Conservation laws

6.2   Fluid mechanics

6.3   Solid mechanics

plasticity, elasticity?

Part III

Classical field theory

Chapter 7

Electromagnetism

Chapter 8

Relativity

Chapter 9

Lagrangian field theory

Part IV

Early quantum theory

Chapter 10

Wave-particle duality

Black body radiation(1901) Photoelectric effect(1905) Compton scattering(1923)
Bohr atom model(1913) Rutherford scattering(1911) Franck-Hertz experiment(1914) De Brogile waves(1924) Electron diffraction Davisson-Germer(1927) George Pagit Thompson(1928)

Chapter 11

Nuclear physics

Chapter 12