Abstract

Qualque chose

Introduction

This is a fairly detailed collection of all the subjects, concepts, theorems and tools I'we studied during my educational trip. There is no request of completeness as well as this "few" concepts must be intended as a leading guide for the student that is approaching mathematics and/or physics from scratch.

1 Elementary Math

- Sum and Difference.
- Multiplication and Division.
- Fraction.
- Powers.
- Logarithm and exponential.

2 Linear Algebra

3 Single-valued Real Analysis

- Topology, open and closed sets.

4 Mechanics

5 Thermodynamics

6 Logic

7 Algorithms and Computations

- Computational cost.
- List, Stack, Arrays, Queries.
- Bubble sort, Merge Sort, Quick Sort.

8 Multi-valued Analysis

- Partial derivatives, derivatives vector ∇.
- Curl and Divergence.

9 Numerical Analysis

10 Algebra

11 Geometry

12 Probability

13 Dynamical Systems

14 Electromagnetism

15 Fluid Dynamics

16 Wave Mechanics

- Wave Equation $\partial_t u - c^2 \Delta u = 0$
- Planar wave
- Poynting Vector

17 Complex Analysis

18 Numerical Analysis for (Partial) Differential Equations

19 Stochastic Processes

20 Differential Geometry

21 Functional Analysis

22 Stochastic Differential Equations

- Itô Integral

23 Partial Differential Equations

- Characteristics Method

24 Advanced Numerical Analysis

25 Analytical Mechanics

26 Quantum Mechanics

- Schrödinger Equation
- Probability Density $\partial_t \psi^* \psi$
- Probability Current Density $\vec{\nabla} \cdot \vec{S}$

- Infinity conditions for the wave function
- Stationary States for a quantum mechanical system
- Klein-Gordon Equation
- Schrödinger Solution as a Markov process
- Simple Harmonic Oscillator
- Ladder Operators a and $a^\dagger$
- Hermite Differential Equation
- 1D Square Well Potential
- Forbidden Regions
- Square Potential Barriers
- Tunneling Effect
- Particle in the box
- Concept of classical limit $\hbar \to 0$
- Gauge Transformations and Landau Gauge
- Landau Levels

27 Statistical Mechanics

28 Solid State Physics

- Boltzman Model
- Einstein Model
- Bebye Model
- Drude Theory

29 Nuclear Physics

30 Mathematical tools for Physics

- Bessel functions
- Special Functions
- Legendre Polynomials
- Spherical harmonics
- Perturbation Theory

31 Advanced Quantum Theory

- Coupling Basis
- Clebsch-Gordan Coefficients
- Isospin
- Coherent State
- Displacement Operator
- Squeezing Operator
- Cross section amplitude coefficient σ

32 Quantum Field Theory

33 Advanced Quantum Field Theory