Classical Mechanics

Code: 66703

Character: Optative **Credits:** 12

Type: Theoretical **Hours by week:** 6

Hours

Theory: 6 **Practice:** 0

General Objective:

Provide the student the most important knowledge of classical mechanics offering a comprehensive and update overview of this subject. The agenda serves with whole implicit knowledge as a reference for predoctoral exam.

Specifics objectives:

In this course the student will complete the training in the lagrangiana formulation of classical mechanics. In addition to this the student will be prepared to the Hamiltonian formulation of classical mechanics. The importance of classical mechanics as the foundation of several basic braches of physics is stressed out in this course. The Student will also be exposed to the differences between integral and integral systems and will also be presented with advanced notions of non-linear phenomena and chaos.
The subjects with asterisk are optional.

Unit 1 Introduction to Newtonian mechanics Review

1.1 Differential equations, Phase space, fixed points, Limit cycles.
1.2 Quantitative analysis of mechanical system in phase space.
1.3 Mechanical systems with N Particles, Energy, Lineal momentum, Angular momentum.

1.4 Basic concepts in chaos.
1.5 Examples.

Unit 2 Lagrangiana formulation

2.1 Generalized coordinates.

2.2 Problems with honolomic and non honolomic constrictions.

2.3 Euler-Lagrange equation, convariance.

2.4 D´Alembert principle. Work virtual.

2.5 Examples.

Unit 3 variational Principle's

3.1 Calculus of variations.

3.2 Hamilton and Fermat principles.

3.3 Equivalence with langrangian formulations

3.4 Examples.

Unit 4 Conservation Laws

4.1 Comprehensive movement.

4.2 symmetry and preserved quantities.

4.3 Noether's theorem.

4.4 Examples.

Unit 5 Principal Field

5.1 Lagrangiana formulation/ formation.

5.2 Kepler´s problem.

5.3 Dispersion.

5.4 Examples.

Unit 6 Oscillation

6.1 Small oscillations (linear). Normal modes.

6.2 Limit continuous systems: Introduction to classical fields.

6.3 Non-linear Oscillations.

6.4 Examples.

Unit 7 Rigid Body

7.1 Non-inertial Reference System. Coriolis force.
7.2 Orthogonal transformations. Euler´s theorem on Rotations.

7.3 Rigid body dynamics.

7.4 Examples.

Unit 8 Hamiltonian Formations

8.1 Phase Space. Legendre transformations. Sympletic structure.

8.2 Hamiltonian function. Hamilton's equations.

8.3 Lagrange and Poisson Parenthesis.

8.4 Liouville´s Theorem and Poincaré's recurrence.

8.5 Examples.

Unit 9 Canonical Transformation

9.1 Preservation of symplectic structure.

9.2 Generative functions.

9.3 The temporal evolution as a canonical transformation.

9.4 Infinitesimal canonical transformation. Noether's theorem and symmetry.

9.5 Examples.

Unit 10 Hamilton-Jacobi Theory

10.1 Hamilton-Jacobi equation.

10.2 Variable distinction.

10.3 Examples.

Unit 11 Action and Angle variables

11.1 Completely integral systems.

11.2 Non integral systems.

11.3 Examples.

Unit 12 Introduction of perturbation theory and non-integral systems

12.1 Series extension* Small Resonance and denominator*.

12.2 Adiabatic invariance.

12.3 Qualitative discussion of kolmogorov's theorem, Arnold and Moser*.

12.4 Introduction of Hamiltonian systems Chaos*.
Examples: mapping with conservation of area, non-forced non-linear oscillator.

Elementary Bibliography

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Complement Bibliography

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- Flores J. y Anaya G., Dinámica del cuerpo rígido, Fondo de Cultura Económica, 1989.
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