# Analytical Mechanics

## Prof. Alessandro Musesti

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims at providing students with the knowledge and methodologies necessary for an analytical approach to the problems of classical mechanics. At the end of the course the student will know the basic concepts of Lagrangian and Hamiltonian mechanics and will be able to study holonomic mechanical systems with finite degrees of freedom using the Lagrangian approach, to find the existence of constants of motion, to linearize the problem around a stable equilibrium.

***Course content***

Center of mass. Angular momentum for a rigid body. The inertia tensor. Huygens-Steiner theorem. Euler’s equations of dynamics. König’s theorem.

Holonomic systems. Velocity and acceleration in Lagrangian coordinates. Lagrange’s equations. Lagrangian function. Kinetic energy. Generalized potential. Kinetic energy theorem. Mechanical energy. Constants of motion. Ignorable variables. Noether's theorem. Action integral. Principle of stationary action.

First order differential systems. Equilibrium and stability. Dirichlet-Lagrange theorem. Instability criterion.

Hamiltonian function. Hamilton’s equations. Legendre transformation. Small oscillations. Action integral in Hamiltonian variables. Canonical transformations. Generating functions. Poisson brackets. Jacobi-Poisson theorem.

***READING LIST***

Lecture notes will be provided during the course.

***TEACHING METHOD***

Classroom lectures.

***Assessment method AND CRITERIA***

There will be both a written and an oral examination. The written examination lasts two hours and will test the expertise of the students in studying holonomic systems, both in Lagrangian and in Hamiltonian formalism. The oral examination will evaluate the knowledge of the student about the theoretical topics of the course and the analysis of specific problems***.*** The relevance of the answers, the appropriate use of specific terminology and the coherent structuring of the exposition will contribute to the assessment.

There is a unique final mark, assessing the written test for 40% and the oral test for the remaining.

***NOTES AND PREREQUISITES***

Some basic notions in Calculus, Physics and Linear Algebra are required. The main useful concepts will be recalled during the course.

*Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.*