Academic subject: Mathematical Physics 2

Degree Class: L–35 – Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2018/2019
		Kind of class: optional	**Year:** 3 / **Period:** 2
			ECTS:7 divided into **ECTS lessons**: 5 **ECTS exe/lab/tutor:** 2

Time management, hours, in–class study hours, out–of–class study hours
lesson: 40 exe/lab/tutor: 30 in–class study: 70 out–of–class study: 105

Language: Italian	**Compulsory Attendance:** no		
Subject Teacher: Lidia R. R. Palese	**Tel:** **e–mail:** lidiarosaria.palese@uniba.it	**Office:** Department of Mathematics Room 29, II Floor	**Office days and hours:** Wednesday 11-13. Other days and times by appointment.

Prerequisites:
Mathematical knowledge which usually is acquired during the first two year of a degree of L–35 class.

Educational objectives:
Mathematical formulation, understanding and resolution of physical problems concerning the motion of olonomic systems.

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
Acquiring fundamental concepts of the classical mechanics, , understanding physical, mathematical and geometrical aspects of a given problem

Applying knowledge and understanding:
Ability to use theoretical knowledge in various dynamical problems.

Making judgements:
Ability to identify mathematical tools and techniques to study physical problems written as mathematical models..

Communication:
Students should acquire the mathematical language and formalism necessary to read and comprehend textbooks, to explain the acquired knowledge .

Lifelong learning skills:
Acquiring suitable learning methods, supported by text consultation and by solving the questions periodically suggested during the course.

Course program

Dynamics of a material point: General, and particolar integrals. First integrals of the motion. Kinetic energy theorem. The first energy integral. Motion of a point subject to a central force. Motion of a point subject to an elastic force. Dynamics of a constraint material point. Motion of a point on a surface without friction . Motion of a point on a curve without friction Mathematical pendulum.

Dynamics of a rigid body. Motion of a free rigid body. Rigid body with a fixed point;:the Euler equations. Rigid body with a fixed axis., with a sliding axis on a fixed line. Principle of the gyroscopic effect. The gyroscope in presence of gravity. Poinsot motions.

Hamilton equations. Legendre transformation and Hamiltonian. General and particolar integral in Hamiltonian formalism. Cyclic coordinates. Poisson brackets and their properties. Routh function: a mixed formulation of the motion problem.

Stability and small oscillations : Lyapunov criteria. Asymptotic stability. Equilibrium stability. Dirichlet theorem. Small oscillations near a stable equilibrium. Linearized equations. Normal coordinates.

Variational principles: elements of variational calculus. Continuous functionals. Maxima and minima of a functional. Euler equations. Hamilton variational principle. Maupertuis principle.

Canonical transformations. Canonical transformations and generating function. Canonical invariants and Poisson brackets. Lagrange brackets. Infinitesimal contact transformations and their applications.

Hamilton-Jacobi equation. The Hamilton Jacobi function.. Separation of variables in Hamilton Jacobi equation. Cyclic coordinates.
Dynamical systems and Cauchy problems. Examples.
Qualitative analysys of the motion: autonomous systems. Phase space.
Systems with one degree of freedom.: Plane phase. Phase velocity. Linearization near a singular point. Classification of the singular points. Examples.

Teaching methods:
Lectures and exercise sessions.

Auxiliary teaching:
Didactic material proided by the teacher

Assessment methods:
Oral exam.

Bibliography:

A. Strumia: MECCANICA RAZIONALE I, II. Edizioni Nautilus Bologna.
M. Fabrizio: Introduzione alla Meccanica Razionale e ai suoi metodi matematici. Zanichelli, 1997.