UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

General information	**Academic year 2022-2023**
Academic subject	**Mathematical Physics 2**
Degree programme	Mathematics
Programme year	Third
Term	Second semester (February 27, 2022 – May 26, 2022)
European Credit Transfer and Accumulation System credits (ECTS)	7
Language	Italian
Attendance	Not compulsory

Lecturer	
Name and surname	Lidia Rosaria Rita Palese
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Department and office	Es.: Department of Mathematics, room 29 second floor
Virtual meeting room	Microsoft Teams Code: **jt79efz**
Web page	Es.: https://www.dm.uniba.it/members/palese
Office hours	Es.: Monday, Wednesday, Friday 10-12 and by e-mail appointment

Syllabus	
Learning objectives	Understanding, mathematical formulation and solving of physical problems concerning the dynamics of holonomic systems.
Course prerequisites	Mathematical knowledge which usually is acquired during the first two years of the Mathematics degree.
Course contents	Dynamics of a material point: General, and particular 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 particular integrals 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. 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 analysis of the motion: autonomous systems. Phase space. Systems with one degree of freedom.: Plane phase. Phase velocity. Linearization at a singular point. Classification of the singular points. Examples.
Reference books	A. Strumia: MECCANICA RAZIONALE II. Edizioni Nautilus Bologna. M. Fabrizio: Introduzione alla Meccanica Razionale e ai suoi metodi matematici. Zanichelli, 1997.
Additional course materials	Didactic material provided by the teacher.

Work schedule				
	Total	Lectures	Hands-on learning (recitations/laboratories /seminars/other)	Self-study
Hours	180	40	30	110
ECTS credits	7	5	2	

Teaching methods	
	Lectures and exercises

Expected learning outcomes	
Knowledge and understanding	Acquisition of the fundamental concepts of classical mechanics and ability to understanding the physical, mathematical and geometric aspects of a physical problem.
Applying knowledge and understanding	Ability to use the acquired methodology in dynamics problems.
Making judgements	Ability to identify the mathematical tools and techniques suitable for formulating and solving physical problems translated into simple mathematical models
Communication skills	Acquisition of the language and mathematical formalism necessary for the understanding of texts, the analysis and resolution of problems, the exposure of acquired knowledge.
Learning skills	Acquisition of an adequate study method, supported by the ability to consulting and understanding the texts as well as to solving exercises and questions periodically proposed during the course.

Assessment and feedback	
Assessment methods	Oral exam
Evaluation criteria	• *Knowledge and understanding*: Ability to understanding physical problems and abstraction • *Applying knowledge and understanding*: Ability to solving theoretical problems

	• *Making judgements*: Critical skills in using mathematical tools in physical problems. • *Communication skills*: Acquisition of a rigorous language to expose the acquired knowledge. • *Learning skills*: Ability to re-elaborate and critically organize the acquired concepts
Grading policy	The vote concerns an oral exam taking into account the theoretical preparation and the ability to solve simple exercises.

Additional information	