COURSE OF STUDY	**THREE-YEAR BACHELOR PROGRAMME IN MATHEMATICS**
ACADEMIC YEAR	**2023-2024**
ACADEMIC SUBJECT	**MATHEMATICAL PHYSICS 2**

General information	
Programme year	Second
Term	Second semester (February 26, 2024 – May 31, 2024)
European Credit Transfer and Accumulation System credits (ECTS)	7
SSD	MAT/07 – Mathematical Physics
Language	Italian
Mode of attendance	Not mandatory

Lecturers		
Name and surname	Fabio Deelan Cunden (instructor of record)	Arcangelo Labianca
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Department and office	Department of Mathematics room 22 second floor	Department of Mathematics room 7 second floor
Virtual meeting room		
Web page	https://www.dm.uniba.it/it/members/cunden	https://www.dm.uniba.it/it/members/labianca
Office hours	By appointment via email	By appointment via email

Work schedule				
	Total	Lectures	Hands-on learning (recitations)	Self-study
Hours	175	40	30	105
ECTS credits	7	5	2	

Learning objectives	
	Hamiltonian mechanics.

Course prerequisites	
	The topics covered in the first two years of a degree in class L-35 are prerequisites for this course. In particular: linear algebra, algebraic structures, differential and integral calculus for functions of one variable, dynamics of particle systems.

Syllabus	
Course contents	Hamiltonian systems: definitions and examples. Hamiltonian flow. Poisson brackets and Lie derivative. Conserved quantities (integral of motion). Examples: free particle, particle in a uniform field, harmonic oscillator. Phase portrait for hamiltonian systems. Variational principles in hamiltonian mechanics. Canonical transformations, equivalent formulations and examples. Symplectic group. Liouville's theorem. Generating functions of canonical transformations. Normal form of quadratic hamiltonians. Action-angle variables. Simple pendulum. Integrable sistems. Liouville-Arnold theorem. Symmetries and conserved quantities: Noether's theorem. Examples: linear systems, Kepler's problem. Introduction to the

	modern theory of integrable systems and Lax pairs. Toda lattice.
Reference books	Lecture notes “Appunti per il corso di Meccanica Analitica" di G. Benettin available at: https://www.math.unipd.it/~benettin/links-MA/ma- 17_10_25.pdf Lecture notes “Appunti sulla Meccanica Analitica" di B. Dubrovin available at: https://people.sissa.it/~dubrovin/meccanica.pdf V. I. Arnold, “Mathematical methods of classical mechanics”, Springer-Verlag, 1978 A. Fasano, S. Marmi, “Meccanica analitica”, Bollati Boringhieri,
Additional course materials	
Repository	E-learning system at dm.uniba.it

Expected learning outcomes	
Knowledge and understanding	Understanding of fundamental concepts and strategies for the study of equations of motion. Learning of appropriate proof techniques and calculation methods.
Applying knowledge and understanding	The material covered in the course is largely used in the study of differential equations of physics.
Soft skills	*DD3 Making judgments:* - Ability to evaluate the consistency of logical reasoning used in a proof. - Ability to identify the right mathematical tools and the right techniques to tackle complex problems.
	DD4 Communication skills: - Acquisition of advanced physical/mathematical language and formalism, necessary for consulting and understanding texts. - Exposure of the knowledge acquired through the description, analysis and resolution of problems.
	DD5 Learning skills: Acquisition of an adequate study method, supported by the consultation of texts and by the resolution of exercises and questions proposed periodically during the course.

Teaching methods	
	In-class lectures and exercise sessions.

Assessment	
Assessment methods	Oral exam tha may include the resolution of an exercise.
Evaluation criteria	*Knowledge and understanding:* acquisition and mastery of the definitions and theoretical results covered by the course. *Applied knowledge and understanding*: ability to apply the acquired theoretical knowledge to the study of partial differential equations; *Making judgments:* critical approach to concepts, ability to choose solution methods and ability to provide examples and

	counterexamples. *Communication skills:* mastery of language and quality of presentation. Ability to learn: ability to organize knowledge, critical reasoning and possible independent study.
Grading policy	The final mark is expressed out of thirty. The minimum mark to pass the exam is 18/30.

Further information	