University of Gdańsk

Subject card

Subject name and code	Introduction to Cosmology, PG_00208572		
Field of study	Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
Education level	Master's studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit	Zakład Oddziaływań Fundamentalnych, Grawitacji i Kosmologii -> Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Thomas Zlosnik	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	E-learning hours included: 0.0						

Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
	Number of study hours	30	0.0	45.0	75

Subject objectives	The goal of this course is to introduce the students to the use of modern theories of physics to the understanding of the state and history of the observable universe.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMU2_W02] has in-depth knowledge in mathematics and mathematical and computational methods, necessary to solve and model physics problems with an elevated level of complexity and deepened in the selected area of physics	The student knows/understands: - The mathematical foundations of Einstein's general relativity (for example tensor calculus, aspects of differential geometry). - How to apply these mathematical methods to describe and determine physical observables in Einstein's general theory of relativity. - Has some knowledge of how we can use the mathematics of probability theory to understand how to compare data from physical experiments to the predictions of physical theories.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task
[FIZMU2_U01] is able to apply the scientific method in solving physical problems, conducting experiments and reasoning	The student knows/understands: - How to analyze data from cosmological experiments. - What the theoretical predictions of Einstein's theory of General Relativity are for the outcome of these experiments. - How to compare theoretical predictions with data using statistical analysis. - How this analysis can enable us to discover new forms of matter and energy (for example dark matter and dark energy)	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written [SU5] implementation of a problem task
[FIZMU2_W01] has in-depth knowledge of various areas of physics; knows the history of the development of physics and its importance for the progress of exact and natural sciences, knowledge of the world and social development; has in-depth knowledge of the current directions of physics development and the fundamental dilemmas of modern civilization	The student knows/understands: - How Einstein's theory of General Relativity can be used to describe space and time in the observable universe. - How Einstein's theory can be used to understand the size, age, and the matter that exists within the observable universe. - How to compare theoretical predictions with data from cosmological experiments. - The thermal history of the universe and the standard model of cosmology. - What open questions exists in cosmology.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task

Subject contents

- Basics of Differential Geometry
- Distance Measures on Static and Non-Static Curved Surfaces
- Spacetimes with Friedmann-Robertson-Walker Symmetry
- The Motion of Light and Matter in Cosmological Spacetimes
- The Thermal History of the Universe
- Introduction to Cosmic Inflation
- Introduction to Dark Matter and Dark Energy
- Open Questions in Cosmology

Prerequisites and co-requisites

Student has knowledge of Einstein's theory of special relativity and mathematical concepts such as manifolds and tensors.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
activity during classes	0.0%	10.0%
final test	51.0%	90.0%

Recommended reading

Basic literature	Schutz 'A First Course in General Relativity' PWN Warszawa ,1995 Foster and Nightingale,'A Short Course in General Relativity', Springer, 1979 Carroll, „Spacetime and Geometry”, Chicago, 2004
Supplementary literature	Dodelson, 'Modern Cosmology', Academic Press, 2003
eResources addresses	

Example issues/ example questions/ tasks being completed	
Work placement	Not applicable

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