University of Gdańsk

Subject card

Subject name and code	General relativity, PG_00182570						
Field of study	Physics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Master's studies		Subject group		Obligatory subject group in the field of study Optional subject group 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		6.0		
Learning profile	academic		Assessment form		exam		
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Denis Dobkowski-Ryłko				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	30.0	0.0	0.0	0.0	75
	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	75		0.0		75.0	150
Subject objectives	The aim of the course is to introduce students to the fundamental concepts and methods of general relativity, as well as its mathematical foundations based on differential geometry. The course covers the analysis of Einsteins equations, their linearization, and the Newtonian limit, as well as topics related to gravitational waves in the linear approximation. Students will study Schwarzschild spacetime, cosmological models, black holes, and contemporary experimental tests of the theory.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZMU2_U09] can work independently or in a team	Collaborates in a team on solving problems in the field of general relativity.	[SU1] oral statement/conversation/ discussion
[FIZMU2_K02] is aware of the conclusive role of experiment in the verification of physical theories; is aware of the scientific method in the accumulation of knowledge	Appreciates and accepts the importance of rigorous mathematical formalism in modeling gravitational and cosmological phenomena.	[SK4] test/exam - oral or written
[FIZMU2_K01] knows the limitations of his own knowledge and skills; can formulate questions precisely; understands the need for further education and other	Is cautious in expressing opinions in the field of general relativity; he is focused on continuously expanding his own knowledge and supporting the education of others in gravitational physics and cosmology	[SK1] oral statement/conversation/ discussion
[FIZMU2_U01] is able to apply the scientific method in solving physical problems, conducting experiments and reasoning	Selects mathematical models for solving and analyzing problems in the theory of relativity and applies appropriate approximations to compare theoretical predictions with experimental results	[SU4] test/exam - oral or written
[FIZMU2_W01] has advanced knowledge of general physics and 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, cognition of the world and social development	Defines the basic concepts of differential geometry used in general relativity, such as spacetime manifold, metric, curvature tensor, and covariant derivatives. Lists the postulates of general relativity as well as the structure of Einstein's equations and their linearization. Has knowledge of gravitational waves, Schwarzschild spacetime, black holes, cosmological models, and modern experimental tests of the theory.	[SW4] test/exam - oral or written
[FIZMU2_U04] can find the necessary information in professional literature, both in databases and in other sources; can reconstruct the reasoning or the course of an experiment described in the literature, taking into account the assumptions and approximations made	Searches for and selects information in the scientific literature concerning general relativity, and is able to reconstruct the line of reasoning leading to the derivation of Einstein's equations.	[SU1] oral statement/conversation/ discussion

Subject contents

- Elements of differential geometry
- Postulates of general relativity
- Einsteins equations
- Linearization of Einsteins equations
- Newtonian limit of general relativity
- Gravitational waves in the linear approximation
- Schwarzschild spacetime
- Experimental tests of general relativity
- Cosmological models
- Black holes

Prerequisites and co-requisites

Passed differential geometry for physicists.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm	51.0%	40.0%
Exam	51.0%	50.0%
Discussion	51.0%	10.0%

Recommended reading

Basic literature	• S.M. Carroll, Spacetime and Geometry: An Introduction to General Relativity • R.M. Wald, General Relativity • C.W. Misner, K.S. Thorne, J.A. Wheeler Gravitation
Supplementary literature	B.F. Schutz, Introduction to general relativity

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

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