University of Gdańsk

Subject card

Subject name and code	Astrophysics, PG_00155825		
Field of study	Physics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish not applicable
Semester of study	4	ECTS credits	3.0
Learning profile	academic	Assessment form	exam
Conducting unit	Division of Atomic and Molecular Spectroscopy and Astrophysics -> Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Piotr Gnaciński	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	0.0	0.0	45

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	45	0.0	45.0	90

Subject objectives

1. To explain the structure of celestial bodies.
2. Understanding the interrelationships and interactions between astrophysical objects.
3. Explain the physical laws responsible for astrophysical phenomena.
4. To become familiar with the research methods used in astrophysics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[FIZL3_W01] has advanced knowledge of physical concepts, principles and theories, understands their historical development and significance not only for physics, but also for other exact and natural sciences and cognition of the world	The student knows: 1. The laws of physics that determine the course of astrophysical phenomena. 2. Astrophysical objects occurring in the Universe and relations between them. 3. Research methods used in astrophysics. 4. The role of astrophysics in the study of the laws of nature. 5. The structure of the Earth, Solar System bodies, Stars, Galaxies and the Universe. 6. The impact of astronomy and astrophysics on the development of physics, mathematics and technology.	[SW4] test/exam - oral or written [SW3] text preparation/written work
[FIZL3_W02] understands the role of physical experiments, mathematical theoretical models approximating reality and computer simulations in the methodology of scientific research; is aware of technological, equipment and methodological limitations in scientific research	The student knows: 1. The laws of physics that determine the course of astrophysical phenomena. 2. Astrophysical objects occurring in the Universe and relations between them. 3. Research methods used in astrophysics. 4. The role of astrophysics in the study of the laws of nature. 5. The structure of the Earth, Solar System bodies, Stars, Galaxies and the Universe. 6. The impact of astronomy and astrophysics on the development of physics, mathematics and technology.	[SW4] test/exam - oral or written [SW3] text preparation/written work
[FIZL3_W05] understands the basic astrophysical phenomena and the laws governing them, knows the basic physical processes occurring in the Universe	The student knows: 1. The laws of physics that determine the course of astrophysical phenomena. 2. Astrophysical objects occurring in the Universe and relations between them. 3. Research methods used in astrophysics. 4. The role of astrophysics in the study of the laws of nature. 5. The structure of the Earth, Solar System bodies, Stars, Galaxies and the Universe. 6. The impact of astronomy and astrophysics on the development of physics, mathematics and technology.	[SW4] test/exam - oral or written [SW3] text preparation/written work
[FIZL3_U01] can formulate basic physical laws using mathematical formalism	Students will be able to formulate basic regularities of astronomical phenomena using mathematical formalism.	[SU3] text preparation/written work [SU4] test/exam - oral or written
[FIZL3_K01] knows the limitations of his own knowledge and understands the need for further education	The student knows the limitations of his own knowledge and understands the need for further education	[SK3] text preparation/written work [SK4] test/exam - oral or written
[FIZL3_W10] has knowledge about the elementary components of matter and the types of fundamental interactions between them, about the manifestations of these interactions in phenomena occurring at various scales from subatomic to astronomic, knows the time and energy scales associated with these phenomena	The student knows: 1. The laws of physics that determine the course of astrophysical phenomena. 2. Astrophysical objects occurring in the Universe and relations between them. 3. Research methods used in astrophysics. 4. The role of astrophysics in the study of the laws of nature. 5. The structure of the Earth, Solar System bodies, Stars, Galaxies and the Universe. 6. The impact of astronomy and astrophysics on the development of physics, mathematics and technology.	[SW4] test/exam - oral or written [SW3] text preparation/written work

Course outcome	Subject outcome	Method of verification
[FIZL3_K05] understands the need and importance of popularizing physical knowledge	Students will understand the need for and importance of popularising knowledge in astronomy, astrophysics.	[SK3] text preparation/written work [SK4] test/exam - oral or written
[FIZL3_U16] can independently plan and implement his own learning	Students are able to plan and implement their own learning independently	[SU3] text preparation/written work [SU4] test/exam - oral or written
[FIZL3_U09] knows how to extrapolate the results obtained in the Earth laboratory to the Universe	The student is able to extrapolate the results obtained in the Earth laboratory to the Universe	[SU3] text preparation/written work [SU4] test/exam - oral or written
[FIZL3_K08] is able to speak competently on basic problems of physics and its applications	Students will be able to express themselves competently on the fundamental problems of astronomy, astrophysics	[SK3] text preparation/written work [SK4] test/exam - oral or written
[FIZL3_K02] can precisely formulate problems to deepen understanding of a given topic	Students will be able to formulate problems accurately in order to deepen their understanding of a given topic.	[SK3] text preparation/written work [SK4] test/exam - oral or written
[FIZL3_U03] can apply the formalism of classical physics to describe phenomena at the macroscopic level	Students will be able to apply the formalism of classical physics to the description of astronomical, astrophysical phenomena.	[SU3] text preparation/written work [SU4] test/exam - oral or written

Subject contents

1. Elements of spherical trigonometry: spherical triangle, horizontal, equatorial and ecliptic coordinate system.
2. Astronomical time: true solar, mean solar and stellar time; calendar.
3. Astronomical observations: optical, radio, gamma-ray and satellite observations. Influence of the Earth's atmosphere on observations.
4 The structure of the Earth and the Earth's atmosphere; the ozone hole, the ionosphere, auroras, the greenhouse effect.
5. Kepler's lows in the context of the Planetary System. Space velocities.
6 Rotational, circular and precessional motion of the Earth.
7. The Earth-Moon system: orbit of the Moon, stellar, synodic and dragon months, solar and lunar eclipses, tides.
8. Review of physical properties of planets, moons and minor bodies of the Planetary System; gravitational resonance; other planetary systems.
9. Basic physical parameters of the Sun: mass, radius, effective temperature, chemical composition. Solar activity. The problem of solar neutrinos.
10. The Internal structure of the Sun - basic equations; thermonuclear reaction cycles; energy transport mechanisms.
11. Luminosities, temperatures, radii and masses of stars. H-R diagram.
12. Double stars and variable stars. Clusters and stellar associations.
13 Interstellar matter: dust and gas components, emission, reflection and dark nebulae.
14. Stellar evolution and its course in the H-R diagram. Late stages in the evolution of massive stars: supernovae, neutron stars, black holes.
15. Structure of the Galaxy: spiral structure, rotation, populations and subsystems. Distribution of interstellar matter in the Galaxy.
16. Other galaxies: classification and physical characteristics, determination of distances, active galaxy nuclei and quasars, galaxy clusters.
17. Elements of cosmology: Hubble's law, basic cosmological models, relic radiation (fluctuations), primordial nucleosynthesis, evolutionary history of the Universe (eras).

Prerequisites and co-requisites

- A. Passed subjects: major subjects from the first and second year of study and mathematical analysis and linear algebra.
- B. Basic knowledge of atomic structure and elementary particles.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	51.0%	50.0%
final test	51.0%	50.0%

Recommended reading

Basic literature	H. Kartunen, P. Kroger, H. Oja, M. Poutanen,K.J. Donner, "Astronomia ogólna" J. Kreiner, Astronomia z Astrofizyką

	Supplementary literature	E. Rybka, Astronomia ogólna J. Stodółkiewicz, Astrofizyka ogólna z elementami geofizyki M. Kubiak, Gwiazdy i materia międzygwiazdowa M. Jaroszyński, Galaktyki i budowa Wszechświata A. Opolski, H. Cugier, T. Ciurla, Wstęp do astrofizyki J. Mietelski, Astronomia w geografii
	eResources addresses	
Example issues/ example questions/ tasks being completed	not applicable	
Work placement	Not applicable	

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