Physics of nature - course description

General information

Course name	Physics of nature
Course ID	13.2-WF-FizP-PN-S18
Faculty	Faculty of Physics and Astronomy
Field of study	Physics
Education profile	academic
Level of studies	First-cycle studies leading to Bachelor's degree
Beginning semester	winter term 2022/2023

Course information

Semester	4
ECTS credits to win	5
Available in specialities	General physics
Course type	obligatory
Teaching language	english
Author of syllabus	• dr hab. Maria Przybylska, prof. UZ

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Exam
Class	30	2	-	-	Credit with grade

Aim of the course

The aim of the course is to show students how physics explains phenomena observed in nature. Students will apply physical laws from different branches of physics to explain various physical and astronomical phenomena. An additional goal is to educate students in the ability to formulate physical problems in the language of mathematics and to apply the mathematical formalisms.

Prerequisites

Foundations of physics 1-IV, mathematical analysis and linear algebra.

Scope

1. General ideas of dimensional theory: dimensional and dimensionless quantities, fundamental and derived units of measurement, dimensional formulas, functional relations between physical quantities

2. Examples of dimensional theory applications: simple pendulum, fluid motion in pipes, motion of a body in a fluid, steady motion of a solid body in a compressible fluid, unsteady motion of a fluid

3. The apparent movement of the Sun on the celestial sphere, ecliptic, seasons, sunrise and sunset, polar day and night

4. Motion of Earth: shape, size and mass of Earth, rotational motion, orbital motion, system Earth-Moon, tides

5. Description of the movement of heavenly bodies, Kepler's laws, eclipses.

6. Basic concepts of fluid mechanics: the control volume, the flow of physical quantity, the rate of accumulation of physical quantity. Fluid properties: density, equation of state, thermal expansion, specific heat.

7. The law of conservation the physical quantity for an infinitesimal fluid volume and its applications:
the mass continuity equation, the equation of conservation of momentum with the various forces (pressure force, gravity, friction, Coriolis), Boussinesq approximation, the Venturi effect).

8. Similarity criteria (Buckingham theorem (Pi theorem)), criteria of similarity, numbers: Strouhal, Froude, Richardson, Reynolds, Rossby'ego, Peclet, Euler.

9. Wave phenomena: surface gravity waves: limiting cases: waves in deep water, waves in shallow water, seiches, internal gravity waves, internal waves in lakes, the propagation of wave energy in motion.

10. Solar spectrum, radiative transfer, blackbody radiation, radiative properties of non-black materials, scattering by air molecules and particles, absorption and emission by gas molecules, optical phenomena

11. Cloud microphysics: water vapor condensation, clouds, growth of cloud droplets, freezing, nucleation of ice particles; growth of ice particles in clouds; thunderstorm electrification

12. Atmospheric dynamics: acting forces: centrifugal and Coriolis forces, gravity, the pressure gradient and frictional force, geostrophic, gradient thermal winds, primitive equations of of large-scale atmospheric motions, their solutions and applications, weather, numerical weather prediction

13. Global climate, energy bilans, atmosphere models, elements of climate and weather, changing of climate

Teaching methods

Traditional lecture, conversational and with discussion of certain problems

Class during which students, leaded by the teacher, solve exercises and discuss problems. Students also prepare a 45-minute presentations on particular problems of environment physics, present them, answer questions, listen to presentations of colleagues and ask them questions.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Student is aware of his knowledge and skills as well as knows opportunities for further training of environmental physics	• K1A_K01	• a discussion	• Lecture • Class
Student can find on their own various teaching materials in Polish and English and develop their skills on the environmental physics.	• K1A_U07	• an evaluation test • an exam - oral, descriptive, test and other	• Lecture • Class
Student knows and understands the selected topics of classical and contemporary physics that allows to understand the physical phenomena of the surrounding world. In particular student is familiar with selected topics of astronomy, physics of atmosphere and fluid	• K1A_W01	• activity during the classes • an evaluation test • an exam - oral, descriptive, test and other	• Lecture • Class
Student can develop a specific problem related to the selected phenomena in nature on the base of the knownn mechanisms. Student applies taught knowledge, in particular the conservation laws to explain the phenomena of fluid and atmospheric dynamics of the surrounding world	• K1A_W03 • K1A_U05	• a discussion • an evaluation test • an exam - oral, descriptive, test and other	• Lecture • Class
The student can prepare a presentation on a given topic related to particular problems of environment physics, and present it to using simple language	• K1A_U06 • K1A_U09	• prezentacja	• Class

Assignment conditions

Class

The final grade of the class is issued on the basis of points obtained from two written tests (with tasks of varying degrees of difficulty, allowing to check whether the student has achieved the effects of learning) and give the oral presentation on a given topic related to particular problems of environment physics.

Lecture.
The necessary condition of accede to the final written exam of the lecture is a positive evaluation of the class. The exam consists of theoretical questions and short exercises to be solved and verifies the effects of learning in the areas of knowledge and skills. Obtaining 50% of points guarantees a positive grade.

The final grade is the arithmetic mean of those of the class and the exam.

Recommended reading

1. L.I. Sedov, Similarity and dimensional methods in mechanics, CRC Press, 1993.
2. J. M. Kreiner, Ziemia i Wszechświat, Wydawnictwo Naukowe UP, Kraków, 2011
3. J.W. Kane, M.M.Sternheim, Fizyka dla przyrodników, vol 1, 2 i 3, Państwowe Wydawnictwo Naukowe 1988
4. S. Przestalski, Elementy fizyki, biofizyki i agrofizyki. WUW, Wrocław 2001
5. B. Cushman-Roisin, Environmetal Fluid Mechanics, available on the author's web page: http://engineering.dartmouth.edu/~cushman/books/EFM.html
6. D. G. Andrews, An introduction to atmospheric physics, 2 ed, Cambridge University Press, 2010
7. C. Smith, Environmental physics,
8. R.E. Gabler, J.F. Petersen, L.M. Trapasso, D. Sack, Physical geography, 9 ed, Brooks/Cole, Cengage Learning
9. J.M. Wallace, P.V. Hobbs, Atmospheric science, 2 ed, Elsevier, 2006
10. Materials provided by a lecturer

Further reading

1. E. Boeker, R. van Grondelle, *Fizyka środowiska*, PWN 2002, English version E. Boeker, R. van Grondelle, Environmental Science, Wiley 2001.

2. F. Cap, Tsunamis and hurricanes, Springer-Verlag, 2006

Notes

Modified by dr Marcin Kośmider (last modification: 04-04-2022 20:47)