Modeling phenomena in nature - opis przedmiotu

Informacje ogólne

Nazwa przedmiotu	Modeling phenomena in nature
Kod przedmiotu	13.2-WF-FizD-MPN-S19
Wydział	~~Wydział Fizyki i Astronomii~~
Kierunek	Fizyka
Profil	ogólnoakademicki
Rodzaj studiów	pierwszego stopnia z tyt. licencjata
Semestr rozpoczęcia	semestr zimowy 2022/2023

Informacje o przedmiocie

Semestr	4
Liczba punktów ECTS do zdobycia	5
Występuje w specjalnościach	Fizyka komputerowa
Typ przedmiotu	obowiązkowy
Język nauczania	angielski
Sylabus opracował	• dr hab. Maria Przybylska, prof. UZ

Formy zajęć

Forma zajęć	Liczba godzin w semestrze (stacjonarne)	Liczba godzin w tygodniu (stacjonarne)	Liczba godzin w semestrze (niestacjonarne)	Liczba godzin w tygodniu (niestacjonarne)	Forma zaliczenia
Wykład	30	2	-	-	Egzamin
Laboratorium	30	2	-	-	Zaliczenie na ocenę

Cel przedmiotu

The aim of the course is to familiarise students with the principles of building of mathematical description of physical phenomena and processes in nature as well as with analytical and numerical studies of obtained mathematical methods

Wymagania wstępne

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

Zakres tematyczny

1. Introduction to modeling of physical processes: types of models, stages of models building, methods of their verification
2. . General ideas of dimensional theory: dimensional and dimensionless quantities, fundamental and derived units of measurement, dimensional formulas, functional relations between physical quantities
3. Examples of dimensional theory applications in mechanics and fluid physics
4. Physical laws and constitutive relations: fundamental laws, constitutive relations, equations, of transport of physical quantities and balance equations: mass, heat, momentum, energy, examples of applications
5. Basic concepts of continuous modeling using differential equations: state, state space, evolution equations
6. Basic methods of analysis of continuous models expressed with the help of differential equations: linearization, expansions in basis functions, WKB approximation
7. Stability and robustness of the model (resistance of solutions to parameters perturbations)
8. Examples of modeling the dynamics of a rigid body and a system of rigid bodies
9. Examples of different compartment models of epidemic spreading SIR, SIR, SI, SIS, SIRS, SEI, SEIR, versions without demographics and with demographics
10. Variational modeling: examples of variation principles, variation approximations, elements of variation calculus, problems with constraints, variation limitations, variation accuracy
11. Examples of advanced models: polymer dynamics and vibrating strings, surface waves on water.

Metody kształcenia

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 modeling of particular physical phenomena in nature present them, answer questions, listen to presentations of colleagues and ask them questions.

Efekty uczenia się i metody weryfikacji osiągania efektów uczenia się

Opis efektu	Symbole efektów	Metody weryfikacji	Forma zajęć
Student is able to give examples of models of physical systems with varying degrees of complexity depending on what effects / interactions have been omitted	• K1A_W03	• egzamin - ustny, opisowy, testowy i inne • kolokwium	• Wykład • Laboratorium
Student can utilise the learnt mathematical models and methods to analyse and design modelling and visualisation algorithms.	• K1A_U04 • K1A_U05	• aktywność w trakcie zajęć • dyskusja • egzamin - ustny, opisowy, testowy i inne • kolokwium	• Wykład • Laboratorium
Student can prepare a presentation on a given topic related to the modeling of a selected physical phenomenon, and presents it to using simple language	• K1A_U06 • K1A_U09	• prezentacja	• Laboratorium
Student is able to independently acquire knowledge and develop their skills regarding the physical description of phenomena occurring in nature using various sources in Polish and a foreign language (English) and modern technologies.	• K1A_U07	• egzamin - ustny, opisowy, testowy i inne • kolokwium • prezentacja	• Wykład • Laboratorium
Student knows the basic concepts of dimensional analysis, is able to provide different types of models used to describe physical phenomena, and provide examples	• K1A_W01 • K1A_W02	• egzamin - ustny, opisowy, testowy i inne • kolokwium	• Wykład • Laboratorium
Student is able to construct models of various physical phenomena using dimensional analysis, fundamental laws, constitutive relations, equations of transport of physical quantities, and equations of budgets of the mass, the heat, the momentum and the energy	• K1A_W03 • K1A_U05	• dyskusja • egzamin - ustny, opisowy, testowy i inne • kolokwium	• Wykład • Laboratorium

Warunki zaliczenia

Class

The final grade of the class is issued on the basis of points obtained from two written tests and give the oral presentation on a modeling of a selected natural phenomenon

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.

Literatura podstawowa

1. L.I. Sedov, Similarity and dimensional methods in mechanics, CRC Press, 1993.
2. E. van Groesen, J. Molenaar, Continuum Modeling in the Physical Sciences, SIAM, Philadelphia, 2007
3. H.T. Banks, H.T. Tran, Mathematical and Experimental Modeling of Physical and Biological Processes, CRC Press, 2009
4. C.A. Smith, S.W. Campbell, A First Course in Differential Equations, Modeling and Simulation, CRC, 2012
5. B. Cushman-Roisin, Environmetal Fluid Mechanics, available on the author's web page: http://www.dartmouth.edu/~cushman/books/EFM-old.html
6. D. G. Andrews, An introduction to atmospheric physics, 2 ed, Cambridge University Press, 2010
7. J.M. Wallace, P.V. Hobbs, Atmospheric science, 2 ed, Elsevier, 2006
8. Materials provided by a lecturer

Literatura uzupełniająca

Uwagi

Zmodyfikowane przez dr Marcin Kośmider (ostatnia modyfikacja: 04-04-2022 20:48)