DESCRIPTION OF TRAINING PROGRAMME

FOT THE DOCTORAL SCHOOL AT THE KAZIMIERZ WIELKI UNIVERSITY

INFORMATION ON COURSE	
Course	**Current research issues**
Type of classes	specialist classes
Academic year	**2021/2022**
Field of science	engineering and technology
Discipline of science	**mechanical engineering**
Class instructor	**dr hab. inż. Mieczysław Cieszko, prof. uczelni** **dr hab. inż. Jacek Jackiewicz, prof. uczelni**
Name and surname of the personal credit / examination	**dr hab. inż. Mieczysław Cieszko/ dr hab. inż. Jacek Jackiewicz**
Number of hours	**30**
Forme of classes	**lecture**
Pass rules	**examination**
Language of lecture	**English**
Framework learning outcomes (8 PRK)	• knows and understands the main trends in the development of the scientific or artistic disciplines covered in the curricula • knows and understands to such an extent that is possible to revise existing paradigms – world heritage, including theoretical foundations, general issues and selected specific issues – specific to a scientific or artistic discipline • is able to critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development • is ready for recognising the importance of knowledge in solving cognitive and practical problems

DETAILED DESCRIPTION OF CLASSES	
Particular learning outcomes	**Methods of verifications of learning outcomes**
Selected methods of transport modeling in materials and materials with a structure. Description of the structure and its influence on the course of processes During the lecture, students will learn the fundamentals of modeling of transport processes in deformable and structured materials. They will learn: basic concepts, concepts and tools of continuum mechanics on the example of fluid mechanics; fundamentals of continuum and stochastic modeling of the pore space structure of porous materials and fluid transport processes. **Current research issues concerning multiscale modeling in damage and fracture mechanics** The students will learn about the advantages and possibilities of using multiscale modeling for damage and fracture mechanics problems. They will know how to select an appropriate analysis method for macroscale and microscale problems. For macroscale issues, they will be able to implement the following methods: the	

finite element method, finite difference method, and finite volume method, whereas, for microscale problems, the molecular dynamics method, the material parameter identification based on inverse problems, the method of cellular automata and the Monte Carlo method, as well.	

PROGRAM CONTENT IMPLEMENTED DURNING CLASSES

Selected methods of transport modeling in materials and materials with a structure. Description of the structure and its influence on the course of processes

Program content implemented during the lectures:

1. Continuum modeling of fluid transport processes: basic concepts, concepts and tools of continuum mechanics; description of kinematics; mass, momentum and energy balance equations; constitutive equations.
2. Continuum modeling of fluid transport in anisotropic porous materials: description of the pore space structure and mass and momentum balance equations.
3. Stochastic modeling of the pore space and processes of capillary transport of liquid in porous materials.

Current research issues concerning multiscale modeling in damage and fracture mechanics

Program content implemented during the lectures:

1. Selected computational methods used in nanomechanics (based on the physics of elementary particles and the knowledge of chemical bonds, as well as the structure of materials), micromechanics (i.e., analysis of materials at the level of their particular components), continuum mechanics (with assumptions regarding continuity of physical quantity fields determined throughout the search for an equivalent macroscopic description for the considering medium by using homogenization methods) and during modeling mechanical systems,
2. Multiscale analysis using hybrid (concurrent) models and hierarchical models,
3. Analytical models of damage mechanics,
4. Phenomenological models of damage mechanics,
5. Selected models of fracture mechanics.

Didactic methods and educational techniques	seminar lecture, discussion, multimedia presentation, solving tasks and problems
Evaluation criteria	attendance at classes, active in discussions and solving tasks, control work
The form and conditions of passing (the form of verification of learning outcomes)	Oral exam
Literature	1. Ostrowska-Maciejewska, Mechanika ciał odkształcalnych, Wydawnictwo Naukowe PWN,1994. 2. Cieszko M., Mechanika cieczy w anizotropowej przestrzeni porów przepuszczalnych materiałów. Zastosowanie przestrzeni Minkowskiego. Rozprawa habilitacyjna. Wydawnictwo Uniwersytetu Kazimierza Wielkiego, Bydgoszcz 2001; 3. Cieszko M., Kempiński M., Czerwiński T., Limit Models of Pore Space Structure of Porous Materials for Determination of Limit Pore Size Distributions Based on Mercury Intrusion Data, Transport in Porous Media, 127, 433-458, 2019. 4. Neimitz A., Mechanika pękania, PWN, Warszawa 1998. 5. Seweryn A., Metody numeryczne w mechanice pękania, Biblioteka Mechaniki Stosowanej, IPPT PAN, Warszawa 2003. 6. Tadmor E.B., Miller R.E.: Modeling Materials: Continuum, Atomistic and Multiscale Techniques. Cambridge University Press 2012.

*niepotrzebne skreślić