Cracow University of Technology

Course syllabus

binding for the doctoral students of the CUT Doctoral School commencing their studies in the academic year 2022/2023

Information on the course

Name of the course in Polish	Mechanika ciał odkształcalnych
Name of the course in English	Mechanics of deformable bodies
Number of the ECTS points	1
Language of instruction	Polish
Category of the course	Choosable
Field of education	Engineering and technology
Discipline of education	Mechanical engineering
Person responsible for the course Contact	Prof. Błażej Skoczeń, *doctor habilitatus* blazej.skoczen@pk.edu.pl

Type of course, number of hours in the study programme curriculum

Semester	Credit type (G / NG)*	Lecture	Practical classes	Laboratory	Computer Lab	Project Class	Seminar
2, 3, 4, 5	G	15	0	0	0	0	0

*G – graded credit, NG – non-graded credit

Course objectives

Code	Objective description
Objective 1	Introduction to the physical phenomena occurring in materials and structures deformed in the elastic and inelastic range
Objective 2	Acquiring the skills of a mathematical description of physical phenomena occurring in materials and structures (construction of constitutive models)
Objective 3	Acquiring the ability to solve problems of mechanics of the material continuum with the use of constructed constitutive models

Learning outcomes

Code	Description of the learning outcome adjusted to the specific characteristics of the discipline	Learning outcome symbol in the CUD DS	Methods of verification
OUTCOMES RELATED TO KNOWLEDGE			
EUW1	The doctoral student is able to identify physical phenomena occurring in materials deformed in the elastic and inelastic range, in the entire temperature range	E_W01, E_W02	Involvement in class activities, a presentation
EUW2	The doctoral student is able to indicate the cause of physical phenomena occurring in the deformed materials in the elastic and inelastic range, in the entire temperature range	E_W01	Involvement in class activities, a presentation

OUTCOMES RELATED TO SKILLS			
EUU1	The doctoral student is able to identify the phenomena occurring in deformed materials, in particular in the scope related to the implementation of the doctoral dissertation	E_U01	A presentation, discussion.
EUU2	The doctoral student is able to build a mathematical model of the phenomena observed in materials deformed in the elastic and inelastic range, for the entire temperature range	E_U01	A presentation, discussion.
OUTCOMES RELATED TO SOCIAL COMPETENCES			
EUK1	The doctoral student is able to refer to the methods of analyzing the problems of mechanics of deformable bodies known in the literature, in particular those related to the implementation of the doctoral dissertation, and to justify the models they use	E_K01, E_K03	Discussion

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No.	Contents	Learning outcomes for the course	No. of hours
LECTURE			
W1	Elements of tensor calculus, the state of strain in Lagrange's and Euler's description, the gradient of deformation, Green and Almansi strain tensors, strain inseparability equations	EKW1	2
W2	Stress state, Cauchy and Pioli-Kirchhoff stress tensors, material derivative, equations of motion and body equilibrium	EKW1	2
W3	Physical foundations of the elastic state, thermodynamic foundations, Duhamel-Neumann relations, formulation of the fundamental problem of the theory of elasticity	EKW1	2
W4	General theorems and equations of elastostatics, Beltrami-Michelle equations, stress functions, equations of the theory of elasticity in cylindrical and spherical coordinates	EKW1, EKW2	1
W5	Inelastic phenomena occurring in materials deformed in the entire temperature range, classical models of plastic flow and creep	EKW1, EKW2	1
W6	Principles of constitutive modelling of materials, axioms of objectivity, locality, entropy production, physical foundations of phenomena occurring in the crystal lattice, Hamilton operator	EKW1, EKW2	2
W7	Multiscale modelling: micro-meso-macro, mesoscopic representative element, basic constitutive equation, classical constitutive models for inelastic states	EKW2, EKU1, EKU2	2
W8	Evolution of material microstructure, modelling of phase transitions, the kinetics of phase change, homogenization theory, micromechanisms in the multi-phase continuum model	EKW2, EKU1, EKU2	1
W9	Modelling of discontinuous plastic flow, the kinetics of the phenomenon, dislocation constitutive model	EKW2, EKU1, EKU2	1

W10	Modelling of a continuum containing micro-damage fields, the kinetics of micro-damage evolution, material model with mechanical and radiation damage, non-local models	EKW2, EKU1, EKU2, EKK1	1

The ECTS points statement

WORKING HOURS SETTLEMENT	
Type of activity	Average number of hours (45 min.) dedicated to the completion of an activity type
SCHEDULED CONTACT HOURS WITH AN ACADEMIC TEACHER	
Hours allotted in the syllabus	15
Consultations	1
Examination / course credit assignment	2
HOURS WITHOUT THE PARTICIPATION OF AN ACADEMIC TEACHER	
Independent study of the course contents	8
Preparation of a paper, a report, a project, a presentation, a discussion	4
ECTS POINTS STATEMENT	
Total number of hours	30
The ECTS points number	1

Preliminary requirements

Lp.	Wymagania
1	Knowledge of differential and integral calculus
2	Knowledge of the English language.

Course credit assignment conditions / method of the final grade calculation

No.	Description
COURSE CREDIT ASSIGNMENT CONDITIONS	
1	75% attendance in class.
2	Presentation of a paper.
METHOD OF THE FINAL GRADE CALCULATION	
Assessment based on the presented paper and discussion.	

Additional information

The thematic scope of the lecture, including the level of advancement of the presented theories and modelling examples, takes into account the scope of knowledge acquired by doctoral students at earlier stages of education.

The course reading list

1	Marsden,J.E., Hughes, T.J.R., *Mathematical Foundations of Elasticity*, 1994, Dover Pub.
2	Ottosen, N., Ristinmaa, M., *The Mechanics of Constitutive Modelling*, 2005, Elsevier.
3	Życzkowski, M., *Combined Loadings in the Theory of Plasticity*, Warszawa, 1981, PWN.
4	Fung, Y. C., *Podstawy mechaniki ciała stałego*, Warszawa, 1969, PWN.