COURSE DESCRIPTION CARD - SYLLABUS

Course name

Elasticity and plasticity theory

Course

Field of study

Mechanical engineering

Area of study (specialization)

Level of study

Second-cycle studies

Form of study

full-time

Year/Semester

2/2

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

Number of hours

Lecture

15

Tutorials

15

Laboratory classes

Projects/seminars

Other (e.g. online)

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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tel. 61 665 23 29

Instytut Mechaniki Stosowanej

Wydział Inżynierii Mechanicznej

ul. Jana Pawła II 24, 60-965 Poznań

Responsible for the course/lecturer:

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Instytut Mechaniki Stosowanej

Wydział Inżynierii Mechanicznej

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Prerequisites

1. Basic knowledge of mechanics, strength of materials and mathematics corresponding to the core curriculum for the first-cycle studies.

2. The ability to to think logically and the skill for search the needed information from various sources.

3. The awareness of the necessity for continuous learning and improving the skills.

Course objective

1. Getting to know and understanding the main concepts, laws and equations of elasticity and plasticity theory.

2. The ability to apply the acquired knowledge to modeling engineering problems, critical analysis of numerical simulation results and inference.

Course-related learning outcomes

Knowledge

1. The student who completed the course can define and explain the basic concepts, laws and equations of elasticity theory.

2. The student knows the differences between a plane stress state and a plane strain state and knows under which conditions both states can be used in modeling the load on solids.

3. He can characterise the basic models of elasto-plastic materials.

Skills

1. The student can make the analysis of the stress and strain states.

2. He can formulate the initial-boundary problems of the elasticity theory related to typical mechanical engineering applications.

3. He understands the index notation and the abbreviated summation convention that are commonly used in solids mechanics and can employ them making simple calculations.

Social competences

1. The student understands the importance of knowledge in the modern world. He is also well aware that the rapid development of knowledge causes the need for lifelong learning.

2. He can organise the processes of learning and self-education.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: The number of points obtained at tutorials and the result of the final test in written are taken into account; credit for a positive grade after obtaining at least 50% of the total points; the grading scale is linear.

Tutorials: Two tests carried out during the semester, assessment of the activity in solving tasks at classes; passing after collecting at least 50% of the total points; linear grading scale.

Programme content

Lectures: The index notation principles and the abbreviated summation convention. Vector and tensor transformation rules within Cartesian coordinate systems. Modeling of external and internal forces exerting on solid bodies. Stress state analysis - the stress vector, the Cauchy stress tensor, the Cauchy stress formula, the principal stresses and the eigenvectors, maximum normal and shear stress. The Langrange (material) and the Euler (spatial) descriptions. The displacement vector, the deformation gradient and the gradient of the dispacement vector. The Green strain tensor and the Almansi strain tensor. Interpretation of the Green strain tensor components. The infinitesimal strain tensor. Interpretation of the infinitesimal strain tensor components. The constitutive relation of linear elasticity. The governing equations of linear elasticity for isotropic material - the stress formulation and the displacement formulation. Initial and boundary conditions. Plain stress and plain strain states. Basic constitutive models for elasto-plastic materials. Plasticity conditions.

Tutorials: The index notation and the abbreviated summation convention. Chosen elements of vectors and tensors algebra and analysis. The stress vector and the stress tensor - the Cauchy stress formula. The normal and the shear components of the stress vector. Determining of eigenvectors and principal stresses. The material and spatial description in kinematics of continuous bodies. Determining of linear and shear strain basing on the Green tensor as well as the infinitesimal strain tensor. Modeling of the boundary conditions for static problems of linear elasticity.

Teaching methods

Lectures: lecture supported by multimedia presentations, solving tasks at the blackboard; discussion.

Tutorials: problem solving, discussion.

The online course is available on the Moodle platform, which includes the presentations from lectures, solutions to tasks with broad comments, proposals for tasks for independent work and issues to help students prepare for the tests.

Bibliography

Basic

1. Sprężystość, Mechanika techniczna t. IV, red. M. Sokołowski, PWN.

2. T. Chmielewski, S. Imiełowski, Wybrane zagadnienia teorii sprężystości i plastyczności, OWPW, 2018.

Additional

1. W. Nowacki, Teoria sprężystości, PWN.

2. G. E. Mase, Theory and problems of continuum mechanics, McGraw Hil, 1970.

3. F. M. Capaldi, Constitutive Modeling of Structural and Biological Materials, Cambridge University Press, 2012.

Breakdown of average student's workload

	Hours	ECTS
Total workload	60	2,0
Classes requiring direct contact with the teacher	34	1,0
Student's own work (literature studies, preparation for tutorials, preparation for tests, self-study with the employing of the online course, solving the proposed tasks) [1]	26	1,0

[1] delete or add other activities as appropriate