UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN

Faculty of Technical Sciences

Course title: Nonlinear solid mechanics

ECTS credit allocation (and other scores): 2

Semester: spring

Level of study: ISCED-7 - second-cycle programmes (EQF-7)

Branch of science: Engineering and technology

Language: English

Number of hours per semester: 15

Course coordinator/ Department and e-mail: Bartosz Moczulak, Department of Mechanics and Fundamentals of Machine Design, bartosz.moczulak@uwm.edu.pl

Type of classes: classes and lectures

Substantive content

CLASSES: Laboratory classes use computer-based tasks in nonlinear solid mechanics. Students analyse the stress tensor, its spherical and deviatoric parts, stress invariants, stress transformation and equivalent stress. They develop elastic-plastic material models, including isotropic and kinematic hardening, and calculate stresses, strains and displacements in simple bar systems. Students trace equilibrium paths using incremental, iterative and combined methods, then analyse an individual structure with geometric and material nonlinearity. Results are documented in reports.

LECTURES: Lectures introduce continuum thermo-mechanics, Lagrangian and Eulerian descriptions, and deformation kinematics. They discuss the balance laws of mass, momentum, angular momentum, energy and entropy. The course covers elastic-plastic equations, yield criteria and plasticity theories, material isotropy and anisotropy, tensile diagrams, and elastic-plastic constitutive models. It also presents numerical methods for nonlinear problems and the operation of computer programs used to solve them, supported by multimedia presentations.

Learning purpose: To explain nonlinear solid mechanics and methods for modelling and solving nonlinear problems.

On completion of the study programme, the graduate will gain:

Knowledge: Knows continuum mechanics, balance laws, elastic-plastic models and nonlinear numerical methods.

Skills: Analyses stress and strain tensors and traces equilibrium paths in nonlinear bar systems.

Social Competencies: Recognises the need to update specialist knowledge throughout professional life.

Basic literature: Nonlinear Solid Mechanics: Theoretical Formulations and Finite Element Solution Methods, Ibrahimbegović Adnan, 2009

Supplementary literature: Adaptive Finite Elements in Linear and Nonlinear Solid and Structural Mechanics, Stein Erwin, 2005

The allocated number of ECTS points consists of:

Contact hours with an academic teacher: 15

Student's independent work: 15