Politechnika Krakowska im. Tadeusza Kościuszki

Karta przedmiotu

obowiązuje studentów rozpoczynających studia w roku akademickim 2021/2022

Wydział Inżynierii Lądowej

Kierunek studiów: Budownictwo | Profil: Ogólnoakademicki

Forma sudiów: stacjonarne | Kod kierunku: BUD

Stopień studiów: II

Specjalności: Structural Design and Management in Civil Engineering (profile: Structural Design),Building and Engineering Constructions (profile: Building Structures),Structural Design and Management in Civil Engineering (profile: Construction Technology and Management)

1 Informacje o przedmiocie

Nazwa przedmiotu	Teoria sprężystości i plastyczności
Nazwa przedmiotu w języku angielskim	Theory of Elasticity and Plasticity
Kod przedmiotu	WIL BUD oIIS C5 21/22
Kategoria przedmiotu	Major subjects
Liczba punktów ECTS	3.00
Semestry	1

2 Rodzaj zajęć, liczba godzin w planie studiów

Semestr	Wykład	Ćwiczenia audytoryjne	Laboratoria	Laboratoria komputerowe	Projekty	Seminarium
1	30	0	0	0	15	0

3 Cele przedmiotu

Cel 1 Introduction of the basic notions of Continuum Mechanics connected with material and spatial description of motion of a continuum concerning kinematics and dynamics of deformable solids as well as constitutive

relations. Formulation of a boundary value problem of non-linear theory of elasticity and specification of conditions enabling linearization of the theory.

Cel 2 Presentation of a boundary value problem of linear theory of elasticity and of chosen methods of solving it - based both on local as well as on global (variational) formulation referring to the Finite Element Method.

Cel 3 Presentation of chosen problems of the linear theory of elasticity and of the methods of finding the solution.

Cel 4 Presentation of basic concepts of the theory of plasticity. Analysis of chosen problems of plastic bearing capacity of structural elements and structural systems.

Cel 5 Preparation of a student for performance of scientific and research tasks.

4 Wymagania wstępne w zakresie wiedzy, umiejętności i innych kompetencji

1 Basic skills in calculus - finding derivatives of a single- and multivariable function, definite and indefinite integrals, curvilinear integrals and multiple integrals.

2 Basic skills in matrix calculus - matrix addition, subtraction and multiplication, calculation of determinants, solving the eigenproblem.

3 Knowledge on classical principles of dynamics of a material points and rigid body.

5 Efekty kształcenia

EK1 Wiedza Student formulates the boundary value problem of non-linear theory of elasticity both in material and in spatial description, defines and explains the physical sense of various measures of deformation and stress, which are used in this formulation.

EK2 Umiejętności For a given deformation in each description student determines appropriate measures of deformation and stress.

EK3 Wiedza Student formulates the boundary value problem of linear theory of elasticity, understands the mathematical structure of obtained system of equations and explains chosen strict and approximate methods of solving it.

EK4 Umiejętności Student uses classical results of linear theory of elasticity in modeling and solving the problems of deformation of deformable solids.

EK5 Wiedza Student defines basic notions of theory of plasticity.

6 Treści programowe

Projekty		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
P1	Eigenvalue problem for a 3x3 and 2x2 symmetric matrix and its application to the deformation gradient	2
P2	Material and spatial description of deformation. Displacement vector, actual configuration, deformation gradient, deformation tensors, strain tensors, change of length, area and volume after deformation.	3
P3	Polar decomposition of the deformation gradient.	2

Projekty		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
P4	Determining body forces and surface tractions for given deformation or given stress state.	2
P5	Solving the problems of plane elastic structures with the use of Finite Difference Method.	2
P6	Bearing capacity of cross-sections subject to chosen load cases.	2
P7	Determining the plastic bearing capacity of a structural system.	2

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W1	Introduction to Continuum Mechanics. Characterization of elastic, plastic and rheological phenomena. Introduction to kinematics - displacement, velocity, acceleration vector, Material and spatial description of motion.	2
W2	Kinematics of deformable solids - deformation gradient and its polar decomposition, stretch tensors, rotation tensor, deformation tensors, strain tensors in material and spatial description. Geometric linearizaton, small strain and small rotation tensors. Interpretation of components of strain tensor and of small strain tensor. Change of length of a material fiber, area of a material surface and volume of a body after deformation.	6
W3	Mass, mass density, conservation of mass. Body forces, surface tractions and stress. Stress vector. Tetrahedron conditions. Tensorial measures of stress state. Laws of motion for deformable solids, equations of motion in material and spatial description.	5
W4	Constitutive relations and postulates concerning formulation of those relations. Elastic material, hyperelastic material. Isotropy, anisotropy, homogeneity, inhomogeneity. Isotropic hyperelastic material. Hooke's material.	2
W5	Linear theory of elasticity. Lame displacement equations, Beltrami-Michell stress compatibility equations. Plane stress and plane strain states. Plane stress and plane strain states. Airy stress function. Levy theorem.	5
W6	Examples of solution of chosen boundary value problems of linear theory of elasticity.	4
W7	Variational methods in theory of elasticity. Principle of Virtual Displacements, Lagrange theorem, Principle of Virtual Forces, Castigliano theorem. Betti-Maxwell reciprocal theorem. Galerkin method in application to variational formulation - Finite Element Method.	3
W8	Chosen features of plastic deformation. Chosen propositions of a yield condition. Yield surface. Active and passive processes, Hencky-Ilyushin theory. Prandtl-Reuss and Levy-Mises theory.	3