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: I

Specjalności: Bez specjalności - studia w języku angielskim

1 Informacje o przedmiocie

Nazwa przedmiotu	Wytrzymałość materiałów
Nazwa przedmiotu w języku angielskim	Strength of Materials
Kod przedmiotu	WIL BUD oIS C25 21/22
Kategoria przedmiotu	Przedmioty kierunkowe
Liczba punktów ECTS	10.00
Semestry	3 4

2 Rodzaj zajęć, liczba godzin w planie studiów

Semestr	Wykład	Ćwiczenia audytoryjne	Laboratoria	Laboratoria komputerowe	Projekty	Seminarium
3	30	0	0	0	30	0
4	30	15	15	0	0	0

3 Cele przedmiotu

Cel 1 To familiarize the students with basic notions, definitions and theorems of the statics of plane bar statically determinate structures.

Cel 2 To familiarize the students with fundamentals of mechanics of continua and boundary problems as theoretical basis to analyze simple and complex cases of strength of materials in order to learn design rules for cross-sections in limit states of bearing capacity and usability.

Cel 3 To familiarize the students with working of beam elements in nonlinear range to establish material reserves in the case of the work in the elastic-plastic range.

Cel 4 To familiarize the students with the stability problem of straight bars (without imperfections) along with the simple analyses of effective design of such bars.

Cel 5 To draw students' attention to the importance of understanding of theoretical and experimental results and the ability to interpret them in order to avoid the error of uncritical confidence in standards and numerical results preparing them for performing scientific work

4 Wymagania wstępne w zakresie wiedzy, umiejętności i innych kompetencji

1 Credit for 1st year of mathematics and 1st semester of theoretical mechanics

5 Efekty kształcenia

EK1 Wiedza Student has ordered and theoretically founded knowledge in the scope of statics of bar structures statically determined.

EK2 Umiejętności Student can draw the cross-section forces diagrams for beams, arches, trusses and combined structures.

EK3 Wiedza Student has knowledge of simple and composed cases of building elements and uses it to design structural elements in the limit states of strength and usability.

EK4 Umiejętności Student can identify the working case and design cross-section in simple stress state as well as in complex stress state.

EK5 Wiedza Student has the basic knowledge of non-elastic behavior of simple beam elements and analyses limit bearing capacity in elastic and plastic range.

EK6 Wiedza Student has sufficient knowledge of the stability problem of straight bars, its importance in design and can analyze simple engineering cases.

EK7 Wiedza Student has basic knowledge of recent trends in the subject matter of the strength of materials.

EK8 Kompetencje społeczne Student can formulate tasks and independtly or in group work on them.

6 Treści programowe

Projekty		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
P1	Classification of structures, loadings and constraints. Geometric rigidity.	2
P2	Determination of constraints reactions.	2
P3	Determination of cross-sectioon forces in simple beams.	2
P4	Determination of cross-sectioon forces in not single span beams.	2

Projekty		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
P5	Determination of cross-sectioon forces in continuous beams.	2
P6	Determination of cross-sectioon forces in slanted beams.	2
P7	Determination of cross-sectioon forces in frames.	2
P8	Determination of cross-sectioon forces in circular and parabolic arches.	2
P9	Determination of cross-sectioon forces in trusses.	2
P10	Determination of cross-sectioon forces in combined structures.	2
P11	Stress state analysis. Static boundary conditions. Shields.	2
P12	Strain state analysis. Kinematic boundary conditions.	2
P13	Constitutive equations of elastic continua.	2
P14	Torsion of bars with circular, rectangular and thin-walled cross-section.	2
P15	Completion and reserve.	2

Ćwiczenia audytoryjne		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
C1	Geometric characteristics of cross-section.	2
C2	Torsion of bars with circular, rectangular and thin-walled cross-section.	2
C3	Simple and biaxial bending.	3
C4	Eccentric tension, cross-section core.	2
C5	Transversal bending.	2
C6	Limit analysis of beams in elastic-plastic range.	2
C7	Analysis of structure in complex stress states.	2

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W1	Introduction to the subject of Strength of Materials (SM). Basic notions and assumptions. Internal and cross-sectional forces.	4

Wykład		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
W2	Cross-section forces in plane bar structures. Static calculations for simple and continuous beams, frames, circular and parabolic arches. Forces in trusses.	10
W3	Theory of stress state - basic definitions and notions. Stress matrix and its transformation at coordinate set rotation. Principal stresses. Equations of equilibrium (Navier's) in material point. Static boundary conditions.	5
W4	Theory of strains state and displacements of material point. Strain matrix and displacements vector. Geometric equations (Cauchy's). Kinematic boundary conditions.	3
W5	Constitutive equations for linearly elastic material (Hooke's). Stiffness and compliance matrices. Boundary problem formulation in linear theory of elasticity.	3
W6	Geometric characteristics of cross-section - static and inertia moments. Matrix of inertia and its transformation due to coordinate set rotation and translation (Steiner's theorems). Principal, central axes and inertia moments.	2
W7	Boundary problem formulation for twisted straight bars. Torsion of bars with circular and rectangular cross-section. Approximate analysis of torsion of thin-walled profiles.	4
W8	Analysis of simple and composed cases (tensions, simple bending, biaxial bending, eccentric tension, transversal bending).	12
W9	Determination of beams' deflections using differential equation and Mohr's analogy.	4
W10	Analysis of axially compressed struts strength - Euler's problem. Cross-section design. Design of steel members.	5
W11	Non-elastic behavior of elastic-plastic materials. Limit elastic and plastic bearing capacity of the cross-section and the bar structure (kinematic method).	4
W12	Elastic energy of continua and its determination for bar member (Maxwell-Mohr's formula). Effect hypotheses for structure elements (Galileo, Coulomb, Tresca-Guest, Huber-Mises-Hencky and Mohr hypotheses).	4

Laboratoria		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
L1	Importance of experiments in Strength of Materials.	2
L2	Introduction to the strain gauges: mechanical and electric.	2
L3	Quasi-static tensile strength test of metal samples. Elastic and non-elastic behaviour of material during tension. Mechanisms of failure.	4

Laboratoria		
Lp	Tematyka zajęć Opis szczegółowy bloków tematycznych	Liczba godzin
L4	Verification of the equations of linear theory of elasticity through determination of elastic modulus from elongation and deflection measurement.	2
L5	Photoelastic analysis of structures. Photoelastic and strain gauges analysis of the stress in beams and shields.	3
L6	Stress state analysis in curved bars and its verification by strain gauges experiments.	2

7 Narzędzia dydaktyczne

N1 Lectures

N2 Exercises

N3 Laboratories

N4 Design classes

N5 Office hours

8 Obciążenie pracą studenta

Forma aktywności	Średnia liczba godzin na zrealizowanie aktywności
Godziny kontaktowe z nauczycielem akademickim, w tym:	
Godziny wynikające z planu studiów	120
Konsultacje przedmiotowe	15
Egzaminy i zaliczenia w sesji	5
Godziny bez udziału nauczyciela akademickiego wynikające z nakładu pracy studenta, w tym:	
Przygotowanie się do zajęć, w tym studiowanie zalecanej literatury	60
Opracowanie wyników	10
Przygotowanie raportu, projektu, prezentacji, dyskusji	80
Sumaryczna liczba godzin dla przedmiotu wynikająca z całego nakładu pracy studenta	**290**
Sumaryczna liczba punktów ECTS dla przedmiotu	10.00