STRENGTH OF MATERIALS I

Course code: **06.4-WILŚ- BUD- WM1- IB07**

Type of course: compulsory

Entry requirements: knowledge of mathematical analysis, general mechanics

Language of instruction: Polish

Director of studies: prof. dr hab. inż. Mieczysław Kuczma
Department of Structural Mechanics

Name of lecturer: prof. dr hab. inż. Mieczysław Kuczma
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Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Exam	
Class					
Laboratory					
Seminar					
Workshop					
Project	30	2		Grade	
Part-time studies					
Lecture	20	2	II	Exam	
Class					
Laboratory					
Seminar					
Workshop					
Project	10	1		Grade	

COURSE CONTENTS:

Lecture

Objectives of the subject "Strength of Materials". Cross-sectional forces (internal forces, internal actions) in bars. Determination of internal forces and their diagrams in statically

determinate bar structures: single-span beams, multi-span beams with hinges, and in statically determinate frames and arches. Differential equilibrium relations for a bar element. Design criteria for a bar in tension. Internal forces in the cross-sections normal and inclined to the bar's axis. Normal (direct) and shear stresses. Displacements. Normal and shear strains. Stress-strain relationship for ductile steels – Hooke's constitutive law. Introductory concepts of structural design. Safety of structures. Strength conditions for a material point, cross-section, member and the structure as a whole. Serviceability limit state. Stress vector and stress tensor. Equilibrium conditions on a surface and differential equilibrium equations. Boundary value problem of linear elasticity theory. Plane state of stress – transformation of components of the stress tensor under rotation of the reference system, principal stresses and their directions. Displacement vector and the state of strain. Geometric relations. Generalized Hooke's law and other models of materials. De Saint Venant's principle. Internal forces versus stresses. Action of normal force. Concentration of stresses. Action of bending moment. Plane cross-section hypothesis. Calculation of stresses in complex (skew) bending. Simple bending. Design rules for members under bending. Action of shear force. Calculation of shear stresses. Shearing in compound beams. Principal stresses in beams. Euler-Bernoulli beam theory – differential equation of beam deflection. Determination of the line of deflection by the direct integration method and Clebsch's method. Calculation of slopes and displacements in beams by the conjugate beam method (area-moment method).

Project

1. *Determination of internal forces in statically determinate bar structures.*
2. *Analysis of stresses and strains in beams.*

LEARNING OUTCOMES:

Competence and skill (i) to identify different instances of loading and material strength, (ii) to determine internal forces, stresses, displacements and strains in bar structures and, (iii) to analyze the states of plane stress and plane strain.

ASSESSMENT CRITERIA:

Lecture – *to pass the exam.*
Project – *to receive a credit for all projects and tests.*

RECOMMENDED READING:

1. Bąk R., Burczyński T.: Wytrzymałość materiałów z elementami ujęcia komputerowego. WNT, Warszawa 2001
   http://www.mes.polsl.gliwice.pl
2. Gawęcki A.: Mechanika materiałów i konstrukcji. t. I-II, Wyd. PP, Poznań 1998
   http://www.uz.zgora.pl/~mkuczma/spis_tresci.pdf
3. Banasiak M., Grossman K., Trombski M.: Zbiór zadań z wytrzymałości materiałów. PWN, Warszawa 1998.
4. Cieślak B.: Metodyczny zbiór zadań z wytrzymałość materiałów. Wyd. PŚl, Gliwice 1984.
5. Jastrzębski P., Mutermilch J., Orłowski W.: Wytrzymałość materiałów. t. I - II, Arkady, Warszawa 1985 (wyd. 2).
6. Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów. WNT, Warszawa 1984.
7. Piechnik S.: Wytrzymałość materiałów dla wydziałów budowlanych. PWN, Warszawa-Kraków 1980.

OPTIONAL READING:

1. Magnucki K., Szyc W.: Wytrzymałość materiałów w zadaniach. Pręty, płyty i powłoki obrotowe. PWN, Warszawa 1999.
2. Walczak J.: Wytrzymałość materiałów oraz podstawy teorii sprężystości i plastyczności. t. I - II. PWN, Warszawa -Kraków 1977.
3. Gross D., Hauger W., Schröder J., Wall W.A.: Technische Mechanik, Band 1: Statik, Band 2: Elastostatik. Springer, Berlin Heidelberg New York 2006, 2007.

4. Gross D., Hauger W., Schröder J., Wall W.A., Rajapakse N., Bonet J.: Engineering Mechanics, Vol. 1: Statics, Vol. 2: Mechanics of Materials. Springer, Berlin Heidelberg New York 2009.
5. Ragab A.R., Bayoumi S.E.: Engineering Solid Mechanics: Fundamentals and Applications. CRC Press, Boca Raton, FL, 1998.