Strength of Materials       1010101121010110028         Field of study       Profile of study (Drak)       Year /Semester         Civil Engineering First-cycle Studies       Subject of read in: Polish       Year /Semester         Dycke of study:       -       Subject of freed in: Polish       Course (compulsory, elective) obligatory         Dycke of study:       -       Form of study (ull-time,part-time)       Course (compulsory, elective) obligatory         Dycke of study:       -       Form of study (ull-time,part-time)       0         Status of the course in the study program (Basic, major, other) (brak)       (university-wide, from another field)       0         Caucation areas and fields of sciences       9       100%       9       100%         Responsible for subject / lecturer:       drin. Zbigniew Pozorski email: zbigniew pozorski (gput,poznan,pl tel. 61 665 20 96       9       100%         Prerequisites in terms of knowledge, skills and social competencies:       Theoretical analysis (including differential and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK. Theoretical work well 6 of KRK.         2       Skills       Mathematics: skills of calculusio, geometry, planimetry, trigonometry - level 6 of KRK. Theoretical mechanics: two biglit of astudy to use hand integral so functions, the ability to use maint: calculus- evel 6 of KRK. Theoretical mechanics: two evel 6 of KRK. Theoretical mechanics: theolity to use the balance equations to determine the reaccions and		STUDY MODULE D	ESCRIPTION FORM			
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Responsible for subject / lecturer:         dr in2. Zbigniew Pozorski         email: zbigniew.pozorski@put.poznan.pl         tel. 61 665 20 96         Budownictwa i Inzynierii Środowiska         ul. Piotrowo 5, 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         1       Mathematics: algebra (including matrix calculus), mathematical analysis (including differential and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK.         Physics at level 5 of KRK.       Theoretical mechanics: knowledge of the equilibrium equations and internal forces in rod elements of a structure - level 6 of KRK.         2       Skills       Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK.         2       Skills       Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK.         3       Social competencies       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:       Study outcomes and reference to the educational results for a field of study         Coupier the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of he structure and mechanics of materials:         Study outcomes and reference	technical sciences					
drint:       Zbigniew.pozorski         email:       zbigniew.pozorski         Budownictwa       Interview 5, 60-965 Poznań         Prerequisites in terms of knowledge, skills and social competencies:         1       Knowledge         1       Mathematics:       algebra (including matrix calculus), mathematical analysis (including differential and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK.         Physics at level 5 of KRK.       Theoretical mechanics: knowledge of the equilibrium equations and internal forces in rod elements of a structure - level 6 of KRK.         2       Skills       Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK.         3       Social competencies       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:       Study outcomes and reference to the educational results for a field of study         Knowledge       I. Student knows basic terms of strength of materials: strengs, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2.       Student knows basic terms of strength of materials: strength hypothesis for inerar theory (obtained at lectures) - [K_W04, K_W05]	Technical s	ciences			9 100%	
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Image: Solution of the structure and mechanics of the course:       Acquire the knowledge       and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK.         Physics at level 5 of KRK.       Theoretical mechanics: knowledge of the equilibrium equations and internal forces in rod elements of a structure - level 6 of KRK.         Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK.         Physics: ability to apply the principles of Newton - level 5 of KRK.         Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems - level 6 of KRK.         Social       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:         Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of the structure and mechanics of materials         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]	,		d social competencies			
elements of a structure - level 6 of KRK.         2       Skills         Ashematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK.         Physics: ability to apply the principles of Newton - level 5 of KRK.         Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems - level 6 of KRK.         3       Social competencies         Assumptions and objectives of the course:         Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of he structure and mechanics of materials         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]	1 Knowledge	and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK.				
2       Skills       matrix calculus - level 6 of KRK.         Physics: ability to apply the principles of Newton - level 5 of KRK.       Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems - level 6 of KRK.         3       Social competencies       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:       Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of he structure and mechanics of materials         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]				s and	d internal forces in rod	
Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems - level 6 of KRK.         Social competencies       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:         Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of he structure and mechanics of materials         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]	2 Skills	matrix calculus - level 6 of KRK.	- -		ctions, the ability to use	
3       Social competencies       Students can work in groups. The student is able to participate in the social life of the university. The student follows the rules of ethics.         Assumptions and objectives of the course:         Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of he structure and mechanics of materials         Study outcomes and reference to the educational results for a field of study         Knowledge:         1. Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]         2. Student knows constitutive and geometrical relations, strength hypothesis for linear theory (obtained at lectures) - [K_W04, K_W05]         3. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]		Theoretical mechanics: the abili	ty to use the balance equations	s to c		
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<ol> <li>Student knows basic terms of strength of materials: stress, strain, displacement, axis of inertia and main axes of the cross-section, isotropy, homogeneity (obtained at lectures) - [K_W04, K_W05]</li> <li>Student knows constitutive and geometrical relations, strength hypothesis for linear theory (obtained at lectures) - K_W04, K_W05]</li> <li>Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]</li> </ol>	Study out	comes and reference to the	educational results for	r a f	field of study	
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K_W04, K_W05] 3. Student knows basis of experimental methods in strength of materials (obtained at lectures and laboratory classes) - K_W04, K_W05]				ertia	and main axes of the cross-	
K_W04, K_W05]	2. Student knows constitu [K_W04, K_W05]	tive and geometrical relations, streng	gth hypothesis for linear theory	(obt	ained at lectures) -	
Skills:	[K_W04, K_W05]	experimental methods in strength of	f materials (obtained at lectures	s and	d laboratory classes) -	
	Skills:					

1. Student is able to determine the stress state in the points of the rod cross-section in the basic cases of action of internal forces (obtained at classes and project classes) - [K\_U04]

2. Student is able to determine displacements of the beam structure using equilibrium differential equations (obtained at lectures and classes) - [K\_U04]

3. Student is able to determine the critical load for basic cases of the axially loaded column (obtained at classes and project classes) -  $[K_U11]$ 

4. Student is able to perform simple laboratory experiments leading to the designation of basic material parameters and strength of building materials (obtained at laboratory classes) -  $[K_U13]$ 

## Social competencies:

1. Student understands the need for learning; can inspire and organize the process of learning of other people (obtained at lectures and classes) - [K\_K03]

2. Student is able to cooperate in a group accepting different roles in the group (obtained at laboratory and project classes) -  $[K_K01]$ 

3. Student is responsible for safety of the own work and work of the team (obtained at laboratory classes) - [K\_K05]

4. Student is able to present the results of his own work (obtained at laboratory and project classes) - [K\_K09]

# Assessment methods of study outcomes

Lectures

Written exam (duration 120 min.) on the date specified at the beginning of the semester (the effect K\_W04, K\_W05, K\_U04, K\_U11, K\_K03).

Classes are passed in the case of positive marks (at least 3.0) of 2 test (duration of each 90 min.). The terms of tests are given at the beginning of the semester (the effect K\_W04, K\_W05, K\_U04, K\_U11, K\_K03).

Laboratory classes are passed in the case of positive marks (at least 3,0) of all reports of laboratory exercises and a minimum of 1 test. The report shall be defending by the team executing the laboratory exercise (oral or written form) (effect K\_U13, K\_K09, K\_K05, K\_K01).

Project classes are passed in the case of positive marks (at least 3,0) of all project tasks. The project tasks should be individually defended (oral or written form) (effect K\_U04, K\_U11, K\_K01, K\_K09).

Scale of the evaluation:

excellent (5,0)

good (4,5)

average (4,0)

passing (3,5)

failed (2,0)

near failed (3,0)

# **Course description**

Idealization of structural models: 1D (rod, truss, beam, column, frame, arch, grid), 2D (plate, slab, shell), 3D (block). Calculation of the effects of actions. The geometrical characteristics of plane figures. Boundary Value Problem of linear elasticity. Internal forces in statically determined rod structures. State of stress and strain in special cases: axial tension, pure bending, bending with shear force, skew bending, eccentric tension, torsion. Displacements of beams. Elastic energy. Constitutive relations for materials. Plasticity. Measures of equivalent stress. Load capacity of beams and columns. Stability of a column. Rheological phenomena. Stress concentration. Fatigue. Elements of mechanics of thin walled rods. Experimental methods.

# Basic bibliography:

1. A. Gawęcki, Mechanika materiałów i konstrukcji prętowych, tomy 1 i 2, Wyd. Pol. Pozn. 19982.

2. A. Garstecki, M. Dębiński, Wytrzymałość materiałów, Podręcznik internetowy,

www.ikb.poznan.pl.http://www.ikb.poznan.pl/almamater/wyklady/wytrzymalosc\_materialow\_04-05/

3. A. Boruszak, R. Sygulski, K. Wrześniowski, Wytrzymałość materiałów, doświadczalne metody badań, PWN, 1984.

# Additional bibliography:

1. S. Piechnik, Wytrzymałość materiałów, Politechnika Krakowska, Kraków 1999

2. A. Jakubowicz, Z. Orłoś, Wytrzymałość Materiałów, tomy 1 i 2, WNT, Warszawa, 1999 i 1997

3. Z. Cywiński, Mechanika budowli w zadaniach. Układy statycznie wyznaczalne, PWN Warszawa 1999

4. S. Timoshenko, Strength of Materials, Krieger Pub Co, 3rd edition, 1983.

5. J. Grabowski, A. Iwanczewska, Zbiór zadań z wytrzymałości materiałów, Oficyna Wydawnicza Politechniki Warszawskiej, 1994.

# Result of average student's workload

Activity	Time (working hours)

Total workload Contact hours	270 128	9
Source of workload	hours	ECTS
Student's wo	rkload	
12. Participation in the final exam (contact hours)	3	
11. Exercises before the final exam (self-study)	12	
10. Exercises before projects defense (self-study)	15	
9. Exercises before classes tests (self-study)	25	
8. Participation in the consultations (contact hours)	5	
7. Completion (at home) project exercises (self-study)	60	
6. Reports from laboratory experiments (self-study)	15	
5. Preparations for laboratory classes (self-study)		15
4. Participation in the project classes (contact hours, practical)	30	
3. Participation in the laboratory classes (contact hours, practical)		15
2. Participation in the classes (contact hours)	30	
<ol> <li>Participation in the lectures (contact hours)</li> </ol>	45	