COURSE SYLLABUS

Polish name of a module	**Wytrzymałość Materiałów**
English name of a module	**Strength of materials**
ISCED classification - Code	0715
ISCED classification - Field of study	*Mechanics and metal trades*
Languages of instruction	*English*
Level of qualification:	*1 – BSc (EQF 6)*
Number of ECTS credit points	*5 ECTS*
Examination:	*A - assignment*
Available in semester:	*S – spring only*

Total number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Other
30	30	15	0	0	0

COURSE DESCRIPTION

COURSE OBJECTIVE

O1. Knowledge of basics of strength of materials in terms of classical approach.

O2. Practical skills in the analysis of the behaviour of the body subjected to external forces and performing simple strength calculations.

O3. Practical skills in determining the mechanical properties of materials.

PREREQUISITES IN TERMS OF KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of mathematic and static in mechanics.
2. Knowledge of safety rules when using laboratory equipment.
3. Ability to perform mathematical activities to solve the assigned tasks.

4. Ability to use of different sources of information and technical drawings.

5. Ability to work independently and in a group.

6. Ability to interpretation and presentation of obtained results.

LEARNING OUTCOMES

LO1 - Theoretical knowledge in terms of simple strength of materials.

LO2 - Calculate stress, strain and displacement in bars and beams for usually used cross sections in engineering practice. Use strength hypotheses to determine reduced stresses in cross sections.

LO3 - Determine the measurement method and perform measurements of mechanical properties of materials.

COURSE CONTENT

Course type – LECTURES	**Number of hours**
L1-4 – Internal forces, internal forces diagrams.	**4**
L5-8 – Moment of inertia of a plane area, polar moment of inertia, product of inertia, Steiner theorem.	**4**
L9-10 – Principal central moments of inertia, central principal axes.	**2**
L11-12 – Tension and compression, normal stress and strain, stress-strain diagrams, Hooke's Law, Young’s modulus.	**2**
L13-14 – Stress and strain tensor, constitutive relations.	**2**
L15-16 – Shear stress and strain, pure shear, shear modulus – modulus of rigidity, shear stress in beams.	**2**
L17-18 – Torsion of round shafts, stress in torsion, relation between Young’s and shear modulus, section modulus.	**2**

L19-22 – Stress in pure bending, curvature of beams, combined stress – bending and tension or compression, normal stress diagrams, axial section modulus, eccentric compression or tension.	**4**
L23-26 – Strength hypotheses, maximum shear stress theory, strain energy of distortion theory.	**4**
L27-28 – Compound stresses, permissible stress.	**2**
L29-30 – Deformation of beams.	**2**
SUM	**30**
Course type – TUTORIAL	**Number of hours**
T1-4 – Internal forces, internal forces diagrams.	**4**
T5-10 – Moment of inertia of a plane area, polar moment of inertia, product of inertia, Steiner theorem. Principal central moments of inertia, central principal axes.	**6**
T11-16 – Stress in pure bending, combined stress – bending and tension or compression, normal stress diagrams, eccentric compression or tension.	**6**
T17-20 – Shear stress, Żurawski formula.	**4**
T21-22 – Torsion of round shafts. Torsional moments, shear stress due to torsion.	**2**
T23-26 – Compound stress, bending and torsion of round shafts, bending and shear in beams.	**4**
T27-28 – Design criteria.	**2**
T29-30 – Deformation of beams due to bending, Clebsch method.	**2**
SUM	**30**
Course type – LABORATORY	**Number of hours**

Lab 1 – Brinell hardness tests.	**1**
Lab 2 – Portable hardness testing.	**1**
Lab 3-4 – Rockwell and Vickers hardness tests.	**2**
Lab 5 – Measurement of impact strength of metals.	**1**
Lab 6-7 – Tension test using Zwick/Roell materials testing machine.	**2**
Lab 8-9 – Compression test using Zwick/Roell materials testing machine.	**2**
Lab 10-11 – Measurement of stress with bond wire strain gauges.	**2**
Lab 12-13 – Measurement of deflection in straight beams	**2**
Lab 14-15 – Bending test using Zwick/Roell materials testing machine.	**2**
SUM	**15**

TEACHING TOOLS

1. Lecture with Power Point presentation, lecture notes, sample problems
2. Tutorials with Power Point presentation, tutorial book
3. Experimental rigs and measuring equipment, laboratory tutorials
4. CUT e-learning platform and other tools for teaching on-line.

METHODS OF ASSESSMENT (F – FORMATIVE, P – SUMMATIVE)

F01 - Conducting a laboratory exercise
F02 - Oral response
F03 - Report on laboratory exercises
F04 - Participation in discussion (class activity)
P01 - Colloquium*

*) a prerequisite for receiving credit is to receive positive grades on all of the above

listed items.

STUDENT WORKLOAD

Ref No.	Form of activity	Average number of hours to complete the activity
1. Contact hours		
1.1	Lectures	30
1.2	Tutorials	30
1.3	Laboratories	15
1.4	Seminars	0
1.5	Project	0
1.6	Office hours	0
1.7	Exam	0
	Total contact hours:	75
2. Self-study hours		
2.1	Preparation for tutorials and the final test	25
2.2	Laboratory preparation, laboratory report preparation	10
2.3	Project preparation	0
2.4	Preparation for the final lecture test	10
2.5	Exam preparation	0
2.6	Literature review	5
	Total self-study hours:	50
	Total student workload:	125
TOTAL NUMBER OF ECTS POINTS FOR THE COURSE		5

Number of **ECTS** points which a student obtains in classes requiring direct teacher participation:	3
Number of **ECTS** points that a student obtains in practical classes, including laboratory and project classes:	2,2

PRIMARY AND SUPPLEMENTARY RESOURCES

1. Blake A.: Handbook of Mechanics, Materials, and Structures, 1985
2. Silva V. D.: Mechanics and Strength of Materials, 2006
3. Ross Carl T.F., Case J., Chilver A., Strength of materials and Structures, Elsevier, 1999
4. Patnaik S., Hopkins D., Strength of Materials, A New Unified Theory for the 21 Century, Elsevier, 2004
5. Timoshenko S.: Strength of materials, part I, part II, Van Nostrand Company, Inc. 1956
6. Z.Dyląg, A.Jakubowicz, Z.Orłoś: Wytrzymałość materiałów. Tom 1, WNT, W-wa 2003
7. Z.Dyląg, A.Jakubowicz, Z.Orłoś: Wytrzymałość materiałów. Tom 2, WNT, W-wa 2003
8. M.E.Niezgodziński, T.Niezgodziński, Zadania z wytrzymałości materiałów, WNT, Warszawa, 1997
9. M.Banasiak, K.Grossman, M.Trombski, Zbiór zadań z wytrzymałości materiałów, PWN, 1998

COURSE COORDINATOR (NAME, SURNAME, DEPARTMENT, E-MAIL)

1. Dr hab. inż. Marcin Kubiak, prof. PCz, Department of Mechanics and Machine Design Fundamentals, marcin.kubiak@pcz.pl
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MATRIX OF LEARNING OUTCOMES

Learning outcome	Reference of the given outcome to outcomes defined for the entire program (CLO)	Course objectives	Course content	Teaching tools	Method of assessment
LO 1	K_W01	O1	L1-30	1-4	P01
LO 2	K_U01	O2	T1-30	1-4	F01-04. P01
LO 3	K_U03	O3	Lab 1-15	1-4	F01-04. P01

FORMS OF ASSESSMENT– DETAILS*

Learning outcomes	Grade 2.0	Grade 3.0	Grade 4.0	Grade 5.0
LO 1	The student did not master the theoretical knowledge of the basics of strength of materials, scoring < 50% on the colloquium	The student partially mastered the theoretical knowledge of the strength of materials, scoring 50% - 65% on the colloquium.	The student has a good grasp of the theoretical knowledge of the basics of the strength of materials, scoring 70 – 85% on the colloquium.	The student has a very good grasp of the theoretical knowledge of the basics of strength of materials, independently acquires and expands knowledge using various sources, scoring

				95 - 100% on the colloquium.
LO 2	The student does not know the principles of calculations for internal forces in beams, does not know the methods of calculations of geometrical properties of cross sections and cannot use stress, strain and displacement calculation methods to solve typical beam problems in strength of materials, scoring < 50% on the final assessment.	The student has a limited understanding of the principles of calculations for internal forces in beams, knows the methods of calculations of geometrical properties of cross sections and can use stress, strain and displacement calculation methods to solve typical beam problems in strength of materials, scoring 50 - 65% on the final assessment.	The student has a good understanding of the principles of calculations for internal forces in beams, knows the methods of calculations of geometrical properties of cross sections and can use stress, strain and displacement calculation methods to solve typical beam problems in strength of materials, scoring 70 - 85% on the final assessment.	The student has a very good understanding of the principles of calculations for internal forces in beams, knows the methods of calculations of geometrical properties of cross sections and can use stress, strain and displacement calculation methods to solve typical beam problems in strength of materials, scoring 95 - 100% on the final assessment.
LO 3	The student lacks the ability to perform laboratory tests,	The student has a limited ability to perform laboratory tests,	The student has the ability to perform laboratory tests, can	The student has the ability to work independently,

	cannot prepare test reports, and does not recognize the importance of knowledge in solving practical problems.	can prepare test reports but cannot interpret and analyse the results of own research.	independently prepare a test report, and makes correct presentations and analyses of the results.	can prepare a test report, can clearly present and discuss the achieved results, and recognizes the importance of knowledge in solving practical problems.

* A half grade of 3.5 is given if the student has achieved the learning outcomes for a grade of 3.0 but has not fully completed the learning outcomes for a grade of 4.0 .A half grade of 4.5 is given if the student has achieved the learning outcomes for a grade of 4.0, but the student has not fully completed the learning outcomes for a grade of 5.0.

OTHER USEFUL COURSE INFORMATION

1. Course topics, resources and literature are provided in classes, in the teacher's office, and in the USOS system.
2. Information on office hours is provided to students during the first class of a given course, and is also placed on website - www.wim.pcz.pl