Annex 9
to the Rector's Ordinance No. 35/19
of 12 June 2019

COURSE SPECIFICATION

Course code	**M#1-S1-ME-305**
Course title in Polish	**Wytrzymałość materiałów**
Course title in English	**Strength of Materials**
Valid from (academic year)	**2019/2020**

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time**
Specialism	**all**
Department responsible	**Department of Mechanics**
Course leader	**Radziszewski Leszek**
Approved by	

COURSE OVERVIEW

Course type	**basic**
Course status	**compulsory**
Language of instruction	English
Semester of delivery	**semester 3**
Pre-requisites	**None**
Examination required (YES/NO)	YES
ECTS value	**6**

Mode of instruction	**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	**30**	**30**	**15**		

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	The student has elementary knowledge of the basic quantities describing the behavior of deformable bodies such as stress, displacement, deformation and understands the meaning of their universality	MiBM-W01 MiBM -W02
	W02	The student has knowledge of simple strength cases for bar structures such as tension, shear, bending, torsion	MiBM -W02 MiBM -W12
	W03	The student knows selected safety issues of materials and structures, such as strength hypotheses, selected theorems and energy methods, elements of the theory of thin plates, thick-walled pipes, the basics of the analysis of structural stability and the phenomenon of material fatigue	MiBM _W01 MiBM _W02 MiBM _W07
Skills	U01	The student is able to perform simple analyzes for simple strength cases such as tension, shear, bending, torsion	MiBM -U13 MiBM -U02 MiBM -U06
	U02	The student is able to perform simple analyzes concerning the determination of displacements in bar structures, the calculation of reduced stresses and the determination of critical loads	MiBM -U13 MiBM -U08
	U03	The student has the ability to assess the usefulness of strength analyzes in solving simple engineering problems	MiBM -U19 MiBM -U13
	U04	The student is able to work individually and in a team	MiBM _U02
Competence	K01	The student understands the need to constantly supplement knowledge in the field of material strength	MiBM -K01 MiBM -K02 MiBM -K04
	K02	The student is aware of the responsibility for their own work and responsibility for the jointly performed task	MiBM _K04

COURSE CONTENT

Type of instruction*	Topics covered
lecture	1. Fundamentals of material strength, tasks, assumptions and simplification of the subject. Material models, classification of construction models.
	2. Definition of stresses. Displacement vector. State of deformation at a point - relative elongations, form deformations, geometrical relationships, main directions.
	3. Elementary physical relationships, tensile diagram for mild and high carbon steel. Hooke's law in unidirectional stress. Generalized Hooke's law.
	4. Bar cross-section geometry - centers of gravity, axial and polar moment of inertia of the section. Main central axes of inertia of the cross-section.
	5. Internal forces in a bar, classification of strength cases. Tension - analysis of displacements, strains and stresses, strength condition.
	6. Statically indeterminate tensile stresses, stresses caused by assembly errors, thermal stresses. Shear, pure shear, technological shear
	7. Torsion of circular bars, analysis of deformations and stresses, maximum stresses and angle of torsion of the shaft, strength condition
	8. Bending, diagrams of shear forces and bending moments, description of deformation of a beam subjected to bending, analysis of stresses in a bending bar, strength condition. Mohr circle.
	9. Shear stresses in bending. Beam deflection lines, differential equation of deflection lines.
	10. Strain energy. Strength hypotheses - the Huber-Mises-Hencky hypothesis, the greatest shear stress hypothesis.

	11. Practical use of strength hypotheses for the analysis of complex cases of bar strength.
	12. Bar buckling - Euler's formula, buckling in the elastic-plastic range.
	13. Deformation energy of bar structures, the principle of reciprocity of Betti's works, determination of displacements in bar structures by the Maxwell-Mohr method.
	14. Elements of the theory of thin plates: assumptions and basic relationships.
	15. Stress concentration. Fatigue of materials
class	1. Determination of the centers of gravity as well as axial and polar moments of inertia of the bar cross-section. Determination of the principal central axes of inertia and principal central moments of inertia. Strength indicators, Mohr circle
	2. Calculation of stresses, deformations and displacements in bars subjected to tension (compression), strength condition.
	3. Problems (tension, compression) statically indeterminate. Pure shear, technical shear. Plane stress analysis - determination of principal stresses, transformation of the stress state.
	4. Deformation state analysis. Torsion of round bars, maximum stresses and shaft torsion angle, strength condition. Colloquium No. 1.
	5. Diagrams of shear forces and bending moments in bending bars, determination of stresses in a bending bar.
	6. Determination of the deflection lines of bending bars. Analysis of the stability of compressed bars.
	7. Determination of Euler's critical force. Tetmajer-Jasiński curves. Analysis of the state of stresses and deformations, Mohr's circles.
	8. Analysis of selected cases of complex strength. Energy of stretching, twisting and bending.
	9. Generalized Hooke's law. Huber strength hypotheses and maximum tangential stresses. Colloquium No. 2.
	10. Reduced stresses. Complex strength of the rod.
	11. Determination of displacements in rod systems using the Maxwell-Mohr method.
	12. Using the Castigliano and Menabrea theorems to determine statically indeterminate displacements and reactions.
	13. Analysis of stresses and deformations of a circular disk.
	14. Strength analysis of thick-walled pipes. Colloquium No. 3
laboratory	1. Static tensile test
	2. Determination of stresses in a bending beam using the strain gauge method
	3. Determination of the center of transverse forces in the channel section
	4. Determination of Euler's critical force
	5. Determination of Young's modulus on the basis of beam deflection analysis, determination of statically indeterminate reaction
	6. Elastooptics I. Determination of the model constant
	7. Elastooptics II. Determination of the shape factor when bending a flat sample with a one-sided notch
	8. Colloquium

*) Please delete rows in the table above that are not applicable.

ASSESSMENT METHODS

Outcome code	Methods of assessment *(Mark with an X where applicable)*					
	Oral examination	**Written examination**	**Test**	**Project**	**Report**	**Other**
W01		X	X		X	
W02		X	X		X	
W03		X	X		X	
U01		X	X		X	
U02		X	X		X	
U03		X	X		X	
U04		X	X		X	

K01		X	X		X	
K02		X	X		X	

ASSESSMENT TYPE AND CRITERIA

Mode of instruction*	Assessment type	Assessment criteria
lecture	**examination assessment**	The pass mark is a minimum of 50% for the final in-class test.
class	non-examination assessment	The pass mark is a minimum of 50% for all the in-class tests.
laboratory	non-examination assessment	The pass mark is a minimum of 50% for each post-lab report.

*) Please delete rows in the table above that are not applicable.

OVERALL STUDENT WORKLOAD

ECTS weighting								
	Activity type	**Student workload**					**Unit**
1.	Scheduled contact hours	L	C	Lab	P	S	h
		30	30	15			
2.	Other contact hours (office hours, examination)	2	2	2			h
3.	**Total number of contact hours**	**81**					h
4.	**Number of ECTS credits for contact hours**	**3,24**					ECTS
5.	**Number of independent study hours**	**24**					h
6.	**Number of ECTS credits for independent study hours**	**0,96**					ECTS
7.	**Number of practical hours**	**45**					h
8.	**Number of ECTS credits for practical hours**	**1,8**					ECTS
9.	**Total study time**	**105**					h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**6**					ECTS

READING LIST

1. Beer, Johnston, & DeWolf, "Mechanics of Materials", 4th Edition, McGraw Hill,
2. Dietmar Gross, Werner Hauger, Jörg Schröder, Wolfgang A. Wall, Nimal Rajapakse, Engineering Mechanics, 2nd Edition, 2018 Springer
3. T.W.B. Kibble F.H. Berkshire, Classical Mechanics, Imperial College Press 5th Edition
4. Vitor Dias da Silva, Mechanics and Strength of Materials, Springer-Verlag Berlin Heidelberg 2006
5. Z. Dyląg, A. Jakubowicz, Z. Orłoś: Wytrzymałość materiałów, WNT, Warszawa, T. 1 1996, T. 2 1997
6. M. Banasiak, K. Grossman, M. Trombski: Zbiór zadań z wytrzymałości materiałów, wydawnictwo naukowe PWN, Warszawa, 1998