MODULE DESCRIPTION

Module code	full-time studies:	**Z-ZIP1-E-403**
	part-time studies:	**Z-ZIPN1-E-403**
Module name	**Strength of Materials**	
Module name in Polish	**Wytrzymałość materiałów**	
Valid from academic year	**2019/2020**	

MODULE PLACEMENT IN THE SYLLABUS

Field of study	**MANAGEMENT AND PRODUCTION ENGINEERING**
Level of education	**1st degree**
Studies profile	**General**
Form and method of conducting classes	**Full-time and Part-time**
Specialisation	**All**
Unit conducting the module	**Department of Production Engineering**
Module co-ordinator	**Dariusz Bojczuk, PhD, DSc**
Approved by:	**Dariusz Bojczuk, PhD, DSc**

MODULE OVERVIEW

Type of subject / group of subjects	**Major**
Module status	**Compulsory**
Language of conducting classes	**English**
Module placement in the syllabus - semester	**Semester IV**
Initial requirements	**No requirements**
Examination (YES/NO)	**YES**
Number of ECTS credit points	**4**

Method of conducting classes		**Lecture**	**Classes**	**Laboratory**	**Project**	**Other**
Per semester	full-time studies:	**30**	**20**			
	part-time studies:	**18**	**12**			

TEACHING RESULTS AND THE METHODS OF ASSESSING TEACHING RESULTS

Category	Symbol	Learning outcomes	Assignations to the directional learning outcomes
Knowledge	W01	A student has advanced knowledge of quantities describing the behaviour of deformed bodies, e.g. stress, dislocation, and strain; a student also understands the meaning of their universality.	ZIP1_W02
	W02	A student has advanced knowledge of simple cases of tensile strength tests concerning rod constructions such as: tension, shearing, bending, and torsion.	ZIP1_W02
	W03	A student knows the selected materials and constructions safety issues such as: tensile strength hypotheses, the selected energy theorems and methods, the elements of the thin plate theory, the fundamentals of the construction stability analysis, as well as the phenomenon of metal fatigue.	ZIP1_W02
Skills	U01	A student can make simple analyses for simple cases of tensile strength tests such as: tension, shearing, bending, and torsion.	ZIP1_U17
	U02	A student can make simple analyses as regards determining rod construction dislocations. A student can also calculate reduced stresses and determine critical loads.	ZIP1_U17
	U03	A student has the ability to assess the usefulness of tensile strength analyses in solving simple engineering issues.	ZIP1_U19
Social competences	K01	A student recognizes the importance of knowledge from the field of strength of materials in solving engineering problems and understands the need of its continuous improvement.	ZIP1_K01

TEACHING CONTENTS

Method of conducting classes	Teaching contents
Lecture	The fundamentals of the strength of materials, tasks, subject assumptions and simplifications. Material models, the classification of construction models. Stress vector and the state of stress at a point. Plane stress analysis – transformation, determining main directions, and Mohr's circle. The dislocation vector. The state of strain at a point – unit elongations, non-dilatational strain, geometric relationships, and main directions. Basic physical structures, soft and high-carbon steel tension diagram. Hooke's law in simple stress. Generalised Hooke's law. The geometry of a rod cross-section – centres of gravity, axial and polar moments of inertia of a cross-section. Main central inertia axes of a cross-section. Internal forces in a rod, the classification of cases of tensile strength tests. Tension – the analysis of dislocation, strains, and stresses; the condition of tensile strength. The cases of statically indeterminable tension, stresses caused by installation errors. Thermal stresses. Torsion of rods with a circular cross-section; the analysis of strains and stresses; maximum stresses and shaft torsion angle, tensile strength condition. Bending, shearing forces and bending moments; the description of beam strains as a result of bending; the analysis of stresses in a bended rod; tensile strength condition.

	Tangential stresses during bending. Beam deflection lines, differential equation of a deflection line. Strain energy – dilatational and non-dilatational strain energy. Tensile strength hypotheses – the Huber-Misers-Hencky hypothesis; the hypothesis of the largest tangential stresses. Practical utilisation of tensile strength hypotheses to analyse complex cases of tensile strength of a rod. Rod buckling – Euler's formula; slenderness ratio and limiting slenderness ratio; elastic and plastic buckling. Rod construction strain energy; Maxwell-Betti reciprocal work theorem; determining dislocation in rod systems with the Maxwell-Mohr method. Thee elements of the thin plate theory: assumptions and basic relationships. Stress concentration. Fatigue of materials.
Classes	The analysis of plane stresses – determining main stresses, transformation of the state of stress. The analysis of the state of stress. Determining centres of gravity as well as axial and polar moments of inertia of a rod cross-section. Determining main central inertia axes and main central inertia moments. Calculating stresses, strains, and dislocations in rods subject to tensions, the condition of tensile strength. The cases of statically indeterminable tension. Test 1 Bending of rods with a circular cross-section, maximum stresses and the shaft torsion angle; the condition of tensile strength. The diagrams of shearing forces and bending moments in bonded rods; determining stresses in a bonded rod. Determining deflection lines of bonded rods. The analysis of the selected cases concerning complex tensile strength. The analysis of stability of compressed rods. Determining dislocations in rod systems with the Maxwell-Mohr method.

METODS OF ASSESSING TEACHING RESULTS

Symbol	Methods of checking the learning outcomes *(select X)*					
	Oral exam	**Written exam**	**Test**	**Project**	**Statement**	**Other**
W01		X	X			
W02		X	X			
W03		X	X			
U01		X	X			
U02		X	X			
U03		X	X			
K01		X	X			

FORM AND CONDITIONS OF PASSING

Form of classes	Form of credit	Passing conditions
Lecture	Exam	Obtaining at least 50% of the exam points
Classes	Credit with grade	Obtaining at least 50% of test points during the class

STUDENT WORKLOAD

<table>
<tr><th colspan="13">Balance of ECTS points</th></tr>
<tr><th rowspan="3">No.</th><th rowspan="3">Type of student's activity</th><th colspan="10">Student's workload</th><th rowspan="3">Unit</th></tr>
<tr><th colspan="5">full-time</th><th colspan="5">part-time</th></tr>
<tr><td rowspan="2">1.</td><td rowspan="2">Participation in the activities</td><td>Lc</td><td>C</td><td>Lb</td><td>P</td><td>O</td><td>Lc</td><td>C</td><td>Lb</td><td>P</td><td>O</td><td rowspan="2">h</td></tr>
<tr><td>30</td><td>20</td><td></td><td></td><td></td><td>18</td><td>12</td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td>Other (consultation, exam)</td><td>4</td><td>2</td><td></td><td></td><td></td><td>4</td><td>2</td><td></td><td></td><td></td><td>h</td></tr>
<tr><td>3.</td><td>Number of hours of a student's assisted work</td><td colspan="5">56</td><td colspan="5">36</td><td>h</td></tr>
<tr><td>4.</td><td>Number of ECTS credit points which are allocated for assisted work</td><td colspan="5">2,2</td><td colspan="5">1,4</td><td>ECTS</td></tr>
<tr><td>5.</td><td>Number of hours of a student's unassisted work</td><td colspan="5">44</td><td colspan="5">64</td><td>h</td></tr>
<tr><td>6.</td><td>Number of ECTS credit points which a student receives for unassisted work</td><td colspan="5">1,8</td><td colspan="5">2,6</td><td>ECTS</td></tr>
<tr><td>7.</td><td>Work input connected with practical classes</td><td colspan="5">40</td><td colspan="5">40</td><td>h</td></tr>
<tr><td>8.</td><td>Number of ECTS credit points which a student receives for practical classes</td><td colspan="5">1,6</td><td colspan="5">1,6</td><td>ECTS</td></tr>
<tr><td>9.</td><td>Total number of hours of a student's work</td><td colspan="5">100</td><td colspan="5">100</td><td>h</td></tr>
<tr><td>10.</td><td>Punkty ECTS za moduł
1 ECTS=25 hours</td><td colspan="10">4</td><td>ECTS</td></tr>
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LITERATURE

1. Bhaskar K., Varadan T. K. (2022), *Strength of materials. A concise textbook,* Springer International Publishing AG.
2. Singh D. K. (2021), *Strength of materials,* Springer Nature Switzerland AG.
3. Kumar B. R. (2022), *Strength of materials,* Taylor & Francis Ltd.