STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Theory of elasticity, plasticity and rheology		**1010102111010116019**
Field of study: **Civil Engineering Second-cycle Studies**	Profile of study (general academic, practical): **(brak)**	Year /Semester: **1 / 1**
Elective path/specialty: **Road and Motorway Engineering**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **30** Classes: **30** Laboratory: **-** Project/seminars: **-**		No. of credits: **3**
Status of the course in the study program (Basic, major, other): **(brak)**	(university-wide, from another field): **(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Has basic knowledge of mathematics, theoretical mechanics, strength of materials, and structural mechanics, such as covered in the Civil/Structural Engineering Studies or other similar types of studies that finished with a Bachelor of Science degree.
2	**Skills**	Is capable of formulating mechanical problems in mathematical terms and of solving algebraic and differential equations, which appear in typical problems of theoretical mechanics, strength of materials and structural mechanics.
3	**Social competencies**	Is aware of the necessity of lifelong learning in order to expand und update his/her knowledge and skills.

Assumptions and objectives of the course:

Acquaintance with basic knowledge of the mechanics of materials and structures and of constitutive modelling of materials as well as acquisition of skills, all of which are essential for solving typical problems in the stress-strength analysis of structural elements.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Knows the notion and physical interpretation of stress and strain tensors and their use in stress-strength analysis of materials - [K_W03]
2. Has knowledge of constitutive laws in elasticity and plasticity of materials - [K_W04]
3. Has knowledge about the theorem of minimum potential energy and equations corresponding to it - [K_W03]
4. Knows the specifics and static analysis methods of two-dimensional problems (plain state of stress or strain, disks) - [K_W04]
5. Knows the specifics and static analysis methods of thin plates - [K_W03]
6. Understands the specifics of elasto-plastic material behaviour and knows methods of ultimate load-carrying capacity analysis of bar structures - [K_W03, K_W04]

Skills:

1. Is capable of examining the differential equilibrium equations of a material continuum - [K_U04]
2. Is capable of calculating the components of strain and stress tensors, and the principle values and directions of the tensor - [K_U04]
3. Is capable of calculating the components of strain and stress tensors by the generalized Hooke`a law - [K_U04]
4. Is capable of solving the plane stress or plain strain problems - [K_U04]
5. Is capable of calculating the internal forces and displacements in elastic plates - [K_U04]
6. Is capable of predicting ultimate load-bearing capacity of beams and simple frame structures - [K_U04]

Social competencies:

1. Is aware of the responsibility for the correctness of conducted analyses and of the need of verifying adopted assumptions and obtained results - [K_K02]
2. Sees the necessity of systematic expanding und updating his/her knowledge and skills - [K_K06]
3. Understands the need of teamwork in solving theoretical and practical problems - [K_K01]

Assessment methods of study outcomes

Lectures

A 90-minute final written test which encompasses two parts; its date is given at the beginning of the semester. The aim of Part 1 is to check knowledge; it consists in answering 4 questions. The aim of Part 2 is to check skills; it consists in solving 2 computation problems.

Classes

A 90-minute final written test in the last week of the semester. The test consists in solving 3 computation problems.

Evaluation of students` activity during classes.

Grading scale:

>=90% - 5,0 (very good)
>=85% - 4,5 (good plus)
>=75% - 4,0 (good)
>=65% - 3,5 (sufficient plus)
>=55% - 3,0 (sufficient, pass)
<54% - 2,0 (failure).

Course description

1. Elements of vector and tensor calculus.
2. State of stress - tensor of stress. Principle values and principle directions of tensor.
3. State of strain - tensor of strain. Strain compatibility equations.
4. Hooke`s law - constitutive equations of elasticity.
5. Theorem of minimum potential energy. Virtual work equation. Lame`s equations. Beltrami-Michell equations.
6. Analysis of plane state problems (plane stress, plane strain, disks).
7. Fundamentals of thin plates.
8. Calculation of internal forces and displacements in plates.
9. Constitutive relations of plasticity. Yield criteria of Tresca and of Huber-Mises-Hencky.
10. Fundamentals of ultimate load-bearing capacity analysis of structures.

Basic bibliography:

1. Brunarski L., Kwiecinski M.: Wstęp do teorii sprężystości i plastyczności, Wyd. PW, Warszawa 1976.
2. Brunarski L., Górecki B., Runkiewicz L.: Zbiór zadań z teorii sprężystości i plastyczności, Wyd. PW, Warszawa 1976.
3. Fung Y. C.: Podstawy mechaniki ciała stałego, PWN, Warszawa 1969.
4. Gawęcki A., Mechanika materiałów i konstrukcji prętowych, t. I+II, Wyd. PP, Poznań 1998.
5. Krzyś W., Życzkowski M.: Sprężystość i plastyczność, PWN, Warszawa 1962.
6. Nowacki W.: Teoria sprężystości, PWN, Warszawa 1970.
7. Skrzypek J.: Plastyczność i pełzanie, PWN, Warszawa 1986.

Additional bibliography:

1. Mase G. E.: Continuum Mechanics, McGraw-Hill Book Comp., 1970.
2. Ragab A.-R., Bayoumi S.E.: Engineering Solid Mechanics. Fundamentals and Applications, CRC, Boca Raton 1999.
3. Stein E., Barthold F.-J.: Elastizitätstheorie, Skript, Hannover 2004.

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in classes	30
3. Participation in consultations, i.e. chosen after class discussions referring to the given subject	2
4. Study for the final test (classes)	19
5. Study for the final test (lectures)	19

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	100	3
Contact hours	62	1
Practical activities	30	1