

STUDY MODULE DESCRIPTION FORM		
Name of the module/subject Elasticity and Plasticity		Code 1010102111010113700
Field of study Structural Engineering Second-cycle Studies	Profile of study (general academic, practical) (brak)	Year /Semester 1 / 1
Elective path/specialty -	Subject offered in: English	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: 15 Laboratory: - Project/seminars: 15		No. of credits 5
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: prof. dr hab. inż. Mieczysław Kuczma, full prof. email: mieczyslaw.kuczma@put.poznan.pl tel. 61 665-2155 Faculty of Civil and Environmental Engineering ul. Piotrowo 5, 60-965 Poznań		
Prerequisites in terms of knowledge, skills and social competencies:		
1	Knowledge	Basic knowledge of the following subjects: mathematics, theoretical mechanics, strength of materials and structural mechanics covered during Civil Engineering or other similar type of studies up to the Bachelor of Science degree
2	Skills	Capability to apply the acquired knowledge and obtain further information from the literature. One is capable to apply the theoretical knowledge to solve practical problems.
3	Social competencies	Awareness about necessity of expending the theoretical knowledge in order to justify its application during the professional career. Understanding the necessity of constant education.
Assumptions and objectives of the course: The goal is focused on use of the theory to solve 2-D elastostatic problems such as torsion and bending of bars, calculation of in- and out-of-plane plates and spherical shells. The students should capture the knowledge of limit-load method for structural analysis.		
Study outcomes and reference to the educational results for a field of study		
Knowledge:		
1. Student knows the terms of stress and strain tensors, displacement vector in the point of deformable elastic body along with the relations between them. - [K_W03]		
2. Student knows the solving methods of two dimensional problems in the field of theory of elasticity - [K_W03]		
3. Student knows the elasto-plastic material models, plasticity conditions and theories describing plastic behaviour - [K_W03]		
Skills:		
1. Student is capable to solve problems involving tensor algebra utilizing absolute, index and matrix notations. - [K_U04]		
2. Student is capable to solve basic boundary condition problems for the lattice and plate girders models - [K_U04]		
3. Student is capable to calculate the ultimate limit strength of simple bar systems - [K_U04, K_U06]		
Social competencies:		
1. Student is capable to work individually as well as in the team - [K_K02]		
2. Student is aware of the responsibility arising from the accuracy of obtained results and is able to provide the interpretation - [K_K02]		
3. Student is aware of the necessity of constant education and knowledge expansion - [K_K10]		
Assessment methods of study outcomes		

<p>Written tests and exercises. The lectures will be summarised by written exam.</p> <p>1) Exam:(two terms: first one during the regular examination period, second during the last chance examination period) - each exam lasts 2,5 hours - each student receives test with individual and unique problems - the final mark is the summation of all the answers provided to the given problems, passing note in the scale 2= fail, 5= very good can be granted after obtaining at least 50% of the maximum amount of points</p> <p>2) Tutoring sessions:</p> <ul style="list-style-type: none"> -2 written tests in the semester -each student receives the set of unique problems which must be solved and described individually (projects) -number of projects: 3 -during the tutoring sessions the individual help will be granted and the solving problems knowledge will be tested - final grade for each project will be based on the quality of the project as well as the result of the quiz - dates of each quiz will be set at the beginning of the semester 		
Course description		
<p>Basic concept and definitions. Analysis of stress. Equilibrium and boundary conditions. Finite deformations and strains. Analysis of strain. Lagrange and Euler coordinates. Strain tensor and its interpretation. Geometrical and constitutive equations. Elastic constants. Conservation of mass and energy. Lamé and Michell's-Beltrami's equations. Energy principles. 2-D stress and strain problems. Airy's stress function. Planar problems in polar coordinates. Boundary problems and methods of calculation. Torsion and bending. Boussinesq's and Flamant's solutions. Theory of thin plates: differential equations, boundary conditions and internal forces. Rectangular and circular plates. Methods of calculations and examples. Thin shells of revolution with symmetric rotational load: membrane theory. Plastic behavior of materials-basic concepts. Plastic deformations and plastic flow. Idealized models of elasto-plastic materials. Yield conditions. Tresca and Huber-von Mises criteria. Elasto-plastic bending of beams, spherical shell subjected to an increasing pressure. Limit load theory. Theorems and examples of calculations.</p>		
Basic bibliography:		
<ol style="list-style-type: none"> 1. Fung Y. C.: Foundations of solid mechanics, Prentice-Hall, Englewood Cliffs, 1965 2. Mase G.E., Theory and problems of continuum mechanics, Mc-Graw Hill , New York 1970 3. Ragab A.-R., Bayoumi S.E.: Engineering Solid Mechanics. Fundamentals and Applications, CRC, Boca Raton 1999. 4. Skrzypek J., Hetnarski R.B.: Plasticity and creep, CRC Press 1993 5. Stein E., Barthold F.-J.: Elastizitätstheorie, Skript, Hannover 2004. 		
Additional bibliography:		
<ol style="list-style-type: none"> 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. Gawęcki A., Mechanika materiałów i konstrukcji prętowych, (tom I+II), Wyd. PP, Poznań 1998 4. Krzys W., Życzkowski M.: Sprężystość i plastyczność, PWN, Warszawa 1962. 5. Nowacki W.: Teoria sprężystości, PWN, Warszawa 1970. 6. Ostrowska-Maciejewska J., Podstawy mechaniki ośrodków ciągłych, PWN, Warszawa 1982 		
Result of average student's workload		
Activity	Time (working hours)	
1. Completing the project during tutoring sessions along with its elaboration	45	
2. Preparation to the exam	35	
3. Independent research of the available literature and solving additional problems	20	
Student's workload		
Source of workload	hours	ECTS
Total workload	100	5
Contact hours	60	3
Practical activities	50	2