STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Theory of elasticity, plasticity and rheology**		Code **1010102111010116019**
Field of study **Civil Engineering Second-cycle Studies**	Profile of study (general academic, practical) **general academic**	Year /Semester **1 / 1**
Elective path/specialty **Roads and Highways**	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) **major**	(university-wide, from another field) **from field**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **3 100%** **3 100%**

Responsible for subject / lecturer:

dr hab. inż. Jerzy Rakowski, prof. nadzw.
email: jerzy.rakowski@put.poznan.pl
tel. 061 6652489
Wydział Budownictwa i Inżynierii Środowiska
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 aquired knowledge and obtain futher information fromthe 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 focussed on use 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 in structure projecting.

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

Knowledge:

1. Student knows the terms of stress and stain 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

Written tests and exercises. The lectures will be summerised by written exam.

1) Exam:(two terms: first one during the regular examination period, second during the last chance examination period) - each exam lasts 3 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

2) Tutioring sessions:

two written tests in the semester

-each student receives the set of unique problems which must be solved and descrived individually (projects) -number of projects: 2

-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

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. Lame 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.

Basic bibliography:

1. Gawęcki A., Mechanika materiałów i konstrukcji prętowych, (tom I+II), Wydawnictwo Politechniki Poznańskiej ,Poznań 1998
2. Stanisławski S., Podstawy teorii sprężystości, Wydawnictwo Politechniki Poznańskiej, Poznań 1963
3. Fung Y.C., Podstawy mechaniki ciała stałego, PWN, Warszawa 1982
4. Ostrowska-Maciejewska J., Podstawy mechaniki ośrodków ciągłych, PWN, Warszawa 1982
5. Brunarski L., Górecki B., Runkiewicz L. ,Zbiór zadań z teorii sprężystości i plastyczności, Wydawnictwo Politechniki Warszawskiej, Warszawa 1975

Additional bibliography:

1. Mase G.E.,Theory and problems of continuum mechanics, Mc-Graw Hill , New York 1970

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	75	3
Contact hours	60	2
Practical activities	30	1