UNIWERSYTET PRZYRODNICZY WE WROCŁAWIU

Theory of elasticity and plasticity

Educational subject description sheet

Basic information

Field of study Civil engineering	**Education cycle** 2025/26
Speciality -	**Subject code** ID000000IBU(P)S.MI1.2586.25
Organizational unit The Faculty of Environmental Engineering and Geodesy	**Lecture languages** english
Study level Second-cycle (engineer) programme	**Mandatory** optional
Study form Full-time	**Block** major subjects (conducted) in foreign languages
Education profile Practical	**Disciplines** civil engineering geodesy and transport
	Subject related to scientific research Yes
	Subject shaping practical skills Tak

Teacher responsible for the subject	Jarosław Rusin
Other teachers conducting classes	Jarosław Rusin, Małgorzata Meissner, Filip Zakęś

Period	**Examination**	**Number of ECTS points**
Semester 1	exam **Activities and hours** lecture: 15 laboratory classes: 30	2.0

Goals

C1	The aim of education is to learn about the spatial issues of the theory of elasticity, description of the state of displacement, deformation and stress, basic equations of the theory of elasticity. In particular, to learn the flat issues of the theory of elasticity, thin plate theory and methods for solving rectangular plates. Learn about the basics of plasticity theory.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	Student knows and understands equations of elasticity theory, relationships between displacements, deformations and stresses. Knows Hooke's generalized law. Knows the theory of thin plates and methods of solving rectangular plates. Understands the basics of plasticity theory. Knows the methods of solving rod systems in limit states.	BU_P7S_WG03, BU_P7S_WG04	written exam, project, performing tasks
Skills – Student can:			
U1	The student is able to formulate equations and relationships in the theory of elasticity. Can determine the state of displacement and stress in thin rectangular plates. Can solve bar systems in the elastic-plastic range. Is able to determine the limit loads in bar systems	BU_P7S_UW03, BU_P7S_UW04	project, performing tasks
Social competences – Student is ready to:			
K1	The student is ready for rational design complex constructions in the elastic range and using the plastic reserve.	BU_P7S_KR06	written exam

Balance of ECTS points

Activity form	Activity hours*
lecture	15
laboratory classes	30
lesson preparation	5
project preparation	5
exam / credit preparation	5

Student workload	**Hours** 60	**ECTS** 2.0
Workload involving teacher	**Hours** 45	**ECTS** 1.7
Practical workload	**Hours** 30	**ECTS** 1.0

* hour means 45 minutes

Study content

No.	Course content	Activities
1.	Spatial issues of the theory of elasticity. Description of displacement, strain and stress. Basic equations of the theory of elasticity. Flat issues in the theory of elasticity. Airy's stress function. Thin plate theory. Stress and strain of a rectangular plate. Methods for solving rectangular plates. Application of Fourier's series. Application of finite difference method. Basics of plasticity theory. Elasto-plastic bending of statically determinate beams. Elasto-plastic bending of statically indeterminate beams. Elasto-plastic bending of frame beams. Determination of limit loads in statically indeterminate bar systems. Elastic and plastic deformation.	lecture
2.	Solving multi-span beams using finite differences. Solving rectangular plates using series approximation and the finite difference method. Determination of load limits and elastic-plastic deformation.	laboratory classes

Course advanced

Teaching methods:

case analysis, project-based learning (PBL), lecture, classes

Activities	Examination methods	Percentage in subject assessment
lecture	written exam	50%
laboratory classes	project, performing tasks	50%

Entry requirements

Knowledge of the strength of materials and structural analysis.

Literature

Obligatory

1. Y.C. Fung, Foundations of Solid Mechanics, Prentice-Hall, 1965
2. L. E. Malvern, Introduction to the Mechanics of a Continuous Medium, Prentice-Hall, 1969
3. Reddy, J. N., Theory and Analysis of Elastic Plates and Shells, CRC Press, Boca Raton, 2006

Optional

1. Atanackovic, Teodor M ; Guran, Ardeshir, Theory of Elasticity for Scientists and Engineers, Springer Science+Business Media, New York, 2000
2. W. D. Pilkey, W. Wunderlich, Mechanics of Structures , Variational and Computational Methods, CRC Press, 1994
3. A. I. Lurie , Alexander Belyaev, Theory of Elasticity, Springer Berlin, Heidelberg, 2005
4. H. Jane Helena, Theory of Elasticity and Plasticity, PHI Learning Pvt. Ltd., 2017

Kierunkowe efekty uczenia się

Kod	Treść
BU_P7S_KR06	Absolwent jest gotów do rozwijania dorobku oraz podtrzymywania etosu zawodu;
BU_P7S_UW03	Absolwent potrafi krytycznie ocenić wyniki analizy numerycznej konstrukcji inżynierskich.
BU_P7S_UW04	Absolwent potrafi wykonać klasyczną analizę statyczną, dynamiczną i stateczności ustrojów prętowych (kratownic, ram i cięgien) statycznie wyznaczalnych i niewyznaczalnych oraz konstrukcji powierzchniowych (tarcz, płyt, membran i powłok).
BU_P7S_WG03	Absolwent zna i rozumie w pogłębionym stopniu zagadnienia Mechaniki Ośrodków Ciągłych. Zna zasady analizy zagadnień statyki, stateczności i dynamiki złożonych konstrukcji prętowych, powierzchniowych oraz bryłowych;
BU_P7S_WG04	Absolwent zna i rozumie w pogłębionym stopniu zagadnienia wytrzymałości materiałów, modelowania materiałów i konstrukcji, teoretycznych Metody Elementów Skończonych oraz ogólnych zasad prowadzenia nieliniowych obliczeń konstrukcji inżynierskich;