COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength and stability of thin-walled structures [S2MwT1-MT>WiSKC]

Course

Field of study
Mathematics in Technology

Year/Semester
2/3

Area of study (specialization)
Modelling in Technology

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

A student has basic knowledge about mathematics, strength of materials, engineering graphics and other areas of studies. A student has theoretical knowledge of areas of studies. A student can solve basic problems of geometry and mathematical analysis. A student can solve basic problems of solid mechanics. A student understands a need for teamwork. A student is aware of connections between mathematics, physics and technical sciences.

Course objective

Introduction to modelling of thin-walled structures, stress calculation, strength conditions, advantages and disadvantages of such structures. Mechanical properties of thin-walled structures, resistance to point load.

Course-related learning outcomes

Knowledge:
1. Graduate has extended and well-founded knowledge in mathematics and has ordered, theoretically founded general knowledge in the subject of analytical mechanics.
2. Graduate has extended and well-founded knowledge in the field of strength of materials, understands basic models and calculation methods used in design.

3. Graduate has knowledge in the area of theory of plasticity and elasticity, is familiar with the basics of the theory of plasticity and elasticity. He/she knows which phenomena in nature and technology refer to the theory of plasticity and elasticity.
4. Graduate has knowledge in the area of computer aided modelling of machine design including simplifying assumptions in modelling, creation of a physical model of a mechanical system.

Skills:
1. Graduate knows how to retrieve information from literature, databases and other properly selected sources, also in English or another language deemed as the language of international communication in the area of the course; knows how to integrate the retrieved information, how to integrate and interpret it and then critically evaluate as well as to how draw conclusions and formulate and fully justify opinions.
2. Is able to work individually and in teams, knows how to use information and communication technologies typically used in implementation of engineering activities, knows how to use a variety of techniques to communicate in a team and in an environment, also in English or another foreign language deemed as the language of international communication in the area of mechanical engineering. Knows how to prepare and deliver an oral presentation in Polish and in a foreign language on detailed issues in mechanics and mechanical engineering.
3. Knows how to formulate selection criteria for a relevant mathematical method to solve a given engineering problem. He/she knows how to apply a relevant mathematical method to solve an engineering problem.
4. Knows how to carry out strength analyses of elements of machines and mechanical systems by means of basic methods of advanced strength analysis of construction, stability, by means of energy-based methods in strength analysis of construction.
5. Knows how to apply basic laws of analytical mechanics and simplified models to solve simple problems in the area of mechanics and mechanical engineering and knows how to select modelling methods in design, how to carry out basic calculations in modelling, how to select effective optimization procedures for practical engineering applications.

Social competences:
1. Is well aware of the necessity for continuous learning; knows how to inspire and organize the process of learning of other people.
2. Is aware of the importance and understanding of non-technical aspects and results of engineering activities including its influence on the environment involving responsibility for decisions taken.
3. Knows how to cooperate and work in teams assuming various roles within.
4. Knows how to prioritize steps in order to carry out a task either defined by him/herself or by others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: Written and oral tests (2 computational tasks and 2 theoretical questions + conversation with the teacher lecture on the issues of strength and stability of thin-walled structures) - <50% - ndst, >51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
Laboratories: A positive result is based on discussion led when doing tests (questions on the theory of those tests). Moreover, students need to conduct all tests and all their reports from tests must be approved.

Programme content

Thin-walled beams: geometric properties of open cross-sections, sectorial coordinates, sectorial moment of inertia, internal forces, bimoment. The twist angle of thin-walled beams, shear and normal stresses of thin-walled beams in torsion. Thin-walled beams used in mechanical engineering. Typical load and support conditions of thin-walled beams. Torsion of rectangular frame. Thin-walled rotational shells: membrane stresses. Samples of thin-walled shells used in mechanical engineering. The edge effect of thin-walled cylindrical shells. Stress concentration at edges of clamped cylindrical shell subjected to uniformly distributed pressure. Practical aspects of the edge effect and pressure vessels. Loss of stability of thin-walled structures. FEM in the strength and stability of thin-walled structures.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.
2. Laboratory exercises: performing laboratory exercises - on-the-job, multimedia presentation, presentation illustrated with examples given on the board, and performing tasks given by the teacher - practical exercises.

Bibliography

Basic
1. Magnucki K., Szyc W., Układy prętowe o cienkościennych przekrojach otwartych. WSP, Zielona Góra 1997.
2. Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
3. Ostwald M., Podstawy wytrzymałości materiałów, Wydawnictwo PP, Poznań, 2007.
4. Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.
5. Magnucka-Balndzi E., Stateczność belek i płyt trójwarstwowych oraz belek cienkościennych kształtowanych na zimno, Rozprawa habilitacyjna, 2010.
Additional
1. Dyląg Z., Jakubowicz A., Orłoś Z. Wytrzymałość materiałów. Wydawnictwa Naukowo-Techniczne, Warszawa, T. I (2003), T. II (2000).
2. Magnucki K. Wytrzymałość i optymalizacja zbiorników cienkościennych. Wyd. Naukowe PWN, Warszawa, Poznań 1990.
3. Niezgodziński M. E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe, Wydawnictwo Naukowo-Techniczne Warszawa 2004.

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50