# COURSE DESCRIPTION CARD - SYLLABUS

Course name

Strength of materials

## Course

Field of study

Aerospace engineering

Year/Semester

2/3

Area of study (specialization)

–

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

polish

Form of study

full-time

Requirements

compulsory

## Number of hours

Lecture

15

Laboratory classes

0

Other (e.g. online)

0

Tutorials

30

Projects/seminars

0

## Number of credit points

3

## Lecturers

Responsible for the course/lecturer:

Piotr Kędzia BEng, PhD

email: piotr.kedzia@put.poznan.pl

tel. 61 665 20 64

Faculty of Mechanical Engineering

ul. Piotrowo 3 60-965 Poznań

Responsible for the course/lecturer:

## Prerequisites

Knowledge: Basic in the field of mathematics, material strength, engineering graphics and other areas of education in the field of study. Structured theoretical knowledge in the field of study.

Skills: Solving basic tasks in geometry and mathematical analysis. Solving basic problems of solid state mechanics. Ability to search for necessary information in literature, databases and catalogs. Using information and communication techniques appropriate to the implementation of engineering tasks. The ability to learn independently. Social competences: Understands the need for continuous learning and acquiring new knowledge.

Social Competence: Understanding the need for lifelong learning and acquiring new knowledge. Understanding the societal impact of engineering activities. Understanding the need for team

collaboration. The student is aware of the mutual dependencies between mathematical and physical knowledge and technical sciences

## Course objective

Getting to know the methods of testing the strength of materials and checking the strength of the structure. Mastering the basic principles of mechanics and strength analysis. Understanding the theoretical and practical problems related to the strength analysis based on the mechanical properties of materials as the basis for the proper design of the structure. Presentation of selected strength issues in an understandable form, i.e. modeling statically indeterminate systems or solving complex strength problems. Indication of the limitations necessary in the construction due to safety and reliability, regulations, standards. Indication of the areas of feasible solutions and effective solutions to the problem. Awareness of the complexity of construction: the need to build and test prototypes, formulate the conditions of safe operation, the need for a systemic approach to problems.

## Course-related learning outcomes

### Knowledge

1. Has extended knowledge of the strength of materials, including the theory of elasticity and plasticity, stress hypotheses, calculation methods for beams, membranes, shafts, joints and other structural elements, as well as methods of testing the strength of materials and the state of deformation and stress in structures [K2A_W12]

### Skills

1. Can use the language of mathematics (differential and integral calculus) to describe simple engineering problems [K2A_U11]

2. Can use learned mathematical theories to create and analyze simple mathematical models of machines and their components as well as simple technical systems. Is able to use integrated with the packages for spatial modeling, programs for the calculation of mechanical structures by the finite element method and correctly interpret their results [K2A_U26]

### Social competences

1. Understands the need for lifelong learning; can inspire and organize the learning process of other people [K2A_K01]

2. Is ready to critically evaluate his knowledge and received content, recognize the importance of knowledge in solving cognitive and practical problems and consult experts in the event of difficulties with solving the problem on his own [K2A_K02]

3. Is aware of the social role of a technical university graduate, and especially understands the need to formulate and transmit to the society, in particular through the mass media, information and opinions on technological achievements and other aspects of engineering activities; makes efforts to provide such information and opinions in a commonly understandable manner [K2A_K08]

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

LECTURE: Completion of the lecture - 5 theoretical issues, 2 computational issues:

<50% - ndst,> 51-60% - dst,> 61-70% - dst plus,> 71-80% - db,> 81-90% - db plus,> 91% - very good

TUTORIALS: Completion of tutorial exercises (3 tests):

<50% - ndst,> 51-60% - dst,> 61-70% - dst plus,> 71-80% - db,> 81-90% - db plus,> 91% - very good

## Programme content

Basic concepts in statics. Definition of force, division of forces, systems of forces. Bonds and bond reactions. Internal forces. Uniaxial state of stresses and deformations. Tension plot. Hooke's Law. Equilibrium conditions for plane force systems. Statically determinate and indeterminate bar systems and bar-beam systems. Tangential stresses, shear strains. Generalized Hooke's law. Allowable stresses, construction safety factor and strength condition. Material strain hypotheses. Moments of inertia of plane figures, the center of gravity of a cross-section, the main central axes of inertia. Steiner theorem. Torsion of shafts and bars with rectangular, thin-walled open and closed sections. Bending of beams with constant and variable stiffness. Diagrams of bending moments and shear forces in bending beams. Normal and tangential stresses in bent beams. Beam deformation (deflection and angle of rotation): analytical method of double integration, Clebsch method. Solving statically indeterminate beams: analytical methods, Clebsch method. Combined strength: compression (tension) with bending and torsion with bending.

## Teaching methods

Informative (conventional) lecture (providing information in a structured way) - may be of a course (introductory) or monographic (specialist) character.

The exercise method (subject exercises, practice exercises) - in the form of auditorium exercises (applying the acquired knowledge in practice - may take various forms: solving cognitive tasks or training psychomotor skills; transforming a conscious activity into a habit through repetition).

## Bibliography

Basic

1. Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000.

2. Ostwald M., Podstawy wytrzymałości materiałów, Wydawnictwo PP, Poznań, 2007.

3. Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.

4. Leyko J., Mechanika ogólna t.1, PWN, Warszawa, 1997

5. Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984

Additional

1. Banasik M., Grossman K., Trombski M., Zbiór zadań z wytrzymałości materiałów. PWN 1992

2. Osiński Z., Mechanika ogólna, PWN, Warszawa, 1994

3. Ostwald M., Wytrzymałość materiałów. Zbiór zadań. Wydawnictwo PP, Poznań, 2008

4. Dyląg Z., Jakubowicz A., Orłoś Z., Wytrzymałość materiałów t.1 i 2, WNT, Warszawa, 2000

5. Niezgodziński M. E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe, Wydawnictwo Naukowo-Techniczne Warszawa 2004.

6. Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981

7. Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 75 | 3,0 |
| Classes requiring direct contact with the teacher | 45 | 2,0 |
| Student's own work (literature studies, preparation for tests/exam) [1] | 30 | 1,0 |

[1] delete or add other activities as appropriate