1. Course number and name

RB-S1-19-W26-32, **Selected engineering problems - Mechanics of Materials**

2. Credits and contact hours*

5 ECTS, lectures: 30 hours**, classes: 3 hours**, project: 35 hours**

3. Instructor's or course coordinator's name

Tomasz Krykowski PhD, DSc/University Professor

4. Text book, title, author, and year

- Timoshenko S.: Strength of Materials, vol. 1, Elementary Theory and Problems, 2004,
- Timoshenko S.: Strength of Materials, vol. 2, Advanced Theory and Problems, 2004,
- Hearn S. J.: Mechanics of Materials, Butterworth Heinemann, Oxford 2000,
- Gere J.M., Goodno B.J.: Mechanics of Materials, Brief Edition, Cengage Learning, 2011.

5. Specific course information

a. brief description of the content of the course (catalog description)

Lectures:
(1) Basic physical models of the mechanic of deformable body - constitutive models, (2) Basis cases of mechanics of materials, (3) Deflection of beams, (4) Theory of stress and strain, material effort hypothesis (5) Basic stability problems.
Classes:
(1) Calculating displacements of simple bar elements using differential equation of the bent axis, (2) Determining the critical force in elements under compression.
Project:
There are six projects to perform: Project No 1 – Determining reactions, displacements and preparing the cross section design in statically indeterminate element under axial compression-tension stress, Project No 2 – The design of beam cross section with reference to bending and determining the distribution of shear stresses in the beam cross section,
Project No 3 – Determining the location of neutral axis and designing the cross section of the element under the skew bending, Project No 4 – Determining the position of a neutral axis and the distribution of stresses in the element under the eccentric compression, Project No 5 – Designing the cross section, determining stresses and the angle of rotation of a statically indeterminate element subjected to torsion, Project No 6 – Determining components of stress and strain tensors, their principal directions and values in the beam element under bending.

b. prerequisites or co-requisites

No prerequisites and additional requirements

c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program

Required.

6. Specific goals for the course

a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic

- Student comprehends assumptions and basic concepts of strength of materials, in particular: a concept of an internal force, sectional forces, a state of stress, a state of strain, constitutive description of material.
- Student comprehends the concept of material effort and its measure as well as basic hypotheses of material effort (failure theories): of the maximum normal stress (Gallileo), maximum shear stress (Tresca), maximum energy of distortion (Huber-Mises).
- Student knows how to apply the design concepts and formulas of strength of materials for practical cases of mechanical engineering.
- Student is able to apply the design concepts for simple and complex cases of stress state.
- Student is able to assess the risk of the assumed simplifications in the design procedures

b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.

K1A_W04, K1A_U03, K1A_U12

7. Brief list of topics to be covered

1. Introduction.
2. Internal forces and cross-sectional forces.
3. Problems of strength of a prismatic bar. The problem of a pure and simple tension/compression (statically determind and undetermined).
4. Pure and simple torsion, torsion of a bar with circular cross-section.
5. Pure and simple bending, unsymmetric bending.
6. Non-uniform bending, shear stress in beams.
7. Bending due to eccentric load.
8. State of stress analysis in a point. A plane state of stress.
9. Strain analysis.
10. Constitutive equations, generalized Hooke’s law for isotropic materials.
11. Beam deflection.
12. Material effort, hypotheses of material effort.
13. Buckling.

*- Consultations were not included in the contact hours

**-per semester