COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength of materials [S1IBio1E>WMa2]

Course

Field of study
Biomedical Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
15

Other
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 can search for necessary information and facts in literature, scientific databases and catalogues. A student can use information and communication techniques for realizing engineering tasks. A student has the ability to self-study. A student understands a need for lifelong learning and acquiring knowledge. A student understands general social results of engineering activities. A student understands a need for teamwork. A student is aware of connections between mathematics, physics, technical sciences, biology and medicine.

Course objective

Familiarizing students with strength of materials and strength tests, teaching students basic concepts of mechanics and strength of materials, presenting theoretical and practical engineering methods of analysing the strength of structures that are based on material properties. Showing the restrictions imposed on structures due to their strength, safety and regulations (standards, law), discussing the methods of solving strength problems in an effective and proper way, highlighting the importance of building and testing prototypes, showing a system approach to solving engineering problems.

Course-related learning outcomes

Knowledge:
1. A student has basic knowledge about mathematics, physics, chemistry and about other fields of science useful for formulating and solving simple biomedical engineering problems.
2. A student knows the basic concepts of mechanics: statics, dynamics and kinematics, knows and understands the principles of statics and conditions for the equilibrium of a rigid body subjected to coplanar forces.
3. A student can describe basic strength tests of materials and structures.
4. A student can calculate external and internal forces and moments, knows how to determine stresses and displacements in bars and trusses, can solve problems of torsion of cylindrical shafts.
5. A student can determine normal stresses in beams subjected to bending. A student has theoretical and practical knowledge about basic strength tests.

Skills:
1. A student can acquire necessary information from literature, scientific databases and catalogues (also English ones).
2. A student can think logically and self-study.
3 .A student can plan and make basic strength experiments.
4. A student can formulate and solve problems of strength of materials considering axial, torsional and bending loads. A student can easily convert between different SI units.
5. A student can assess and make a critical analysis of existing technical solutions in the area of biomedical engineering. Basing of those analyses a student can propose improvements in their strength.

Social competences:
1. A student can understand the need for lifelong learning, can inspire others to do this and can organise learning for others.
2. A student can cooperate with others and take on a different role in a group.
3. A student can set priorities when realizing his own and other people tasks.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Exam (3 problems to solve and 5 theoretical issues from lectures):
-51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
In order to receive a positive grade and pass the course a student needs to achieve more than 50% of total points in each test. The final grade is based on the following rules:
very good - if the ratio of sums of achieved and total points is bigger than 91%,
good plus - if the ratio of sums of achieved and total points is between 81-90%,
good - if the ratio of sums of achieved and total points is between 71-80%,
sufficient plus - if the ratio of sums of achieved and total points is between 61-70%,
sufficient - if the ratio of sums of achieved and total points is between 51-60%.
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

Lecture:
Bending of beams – statically determinate and statically indeterminate problems.
Combined strength.

Laboratories:
1. Tensile testing.
2. Hardness measurement using Brinell, Vickers, Poldi, and Rockwell methods.
3. Microhardness measurement using the Vickers method.
4. Material fatigue.
5. Impact testing. Characteristics of springs.
6. Strain gauge measurements.

Course topics

Lecture:
Bending of beams with constant and variable stiffness. Diagrams of bending moments and shear forces in bent beams. Normal and shear stresses in bent beams.
Beam deformation (deflection and angle of rotation): analytical method of double integration, Clebsch's method, analytical-graphical method (method of fictitious loads), and the displacement comparison method (superposition method).
Solving statically indeterminate beams: analytical methods, Clebsch's method, superposition method, and the three-moment equation method.
Eccentric compression. Neutral axis equation.
Combined strength: compression (tension) with bending and torsion with bending.

Laboratories:
1. Tensile testing.
2. Hardness measurement using Brinell, Vickers, Poldi, and Rockwell methods.
3. Microhardness measurement using the Vickers method.
4. Material fatigue.
5. Impact testing. Characteristics of springs.
6. Strain gauge measurements.

Teaching methods

1. Lecture: presentation illustrated with examples administered on the blackboard, solving tasks.
3. Laboratory exercises: conducting experiments, solving tasks, discussion.

Bibliography

Basic:
1.N. Willems, T. J. Easley, S. T. Rolfe, Strength of Materials, Mc Graw Hill Book Company, 198 1.
2. M. Gere, S. Timoshenko, Mechanics of Materials, PWS Kent Publishing Company, Bo st on, 1984
3. K. Bhaskar , T.K. Varadan , Strength of Materials: A Concise Textbook , Springer Nature,
4. Vitor Dias da Silva, Mechanics and Strength od Materials, Springer Verlag Berlin and Heidelberg GmbH & Co. KG, 2005.
5. D. S. Prakash Rao , Introduction to Strength of Materials , Universities Press. 2002.

Supplementary:
Standards, strength tables.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	28	1,00