module title: **Strength of materials**		
field of study: **Mechanical Engineering**	type of study: **full-time**	course code: **B5_12**
course: **Computer Modelling & Simulation**	degree: **Bachelor (BSc)**	year: **II** semester: **III**
type of classes: **lecture, tutorials, laboratory**	hours per semester: **30LE, 15T, 30Lab**	No of ECTS credits: **6**

MODULE DESCRIPTION

TARGETS

T1. Knowledge of basics of strength of materials in terms of classical approach.
T2. Practical skills in the analysis of the behavior of the body subjected to external forces and performing simple strength calculations.
T3. Practical skills in determining the mechanical properties of materials.

PREREQUISITES & ADDITIONAL REQUIREMENTS

R1. Knowledge of mathematic and static in mechanics.
R2. Knowledge of safety rules when using laboratory equipment.
R3. Ability to perform mathematical activities to solve the assigned tasks.
R4. Ability to use of different sources of information and technical drawings.
R5. Ability to work independently and in a group.
R6. Ability to interpretation and presentation of obtained results.

LEARNING OUTCOMES

LO1. Theoretical knowledge in terms of simple strength of materials.
LO2. General knowledge about stress and strain tensor, constitutive relations, plane stress and strain states.
LO3. Ability to define internal forces in beams and geometrical properties of the cross section of beams.
LO4. Calculate stress, strain and displacement in bars and beams for usually used cross sections in engineering practice. Use strength hypotheses to determine cross section geometry.
LO5. Knows the operating principles of selected laboratory equipment in strength of materials laboratory.
LO6. Determine the measurement method and perform measurements of mechanical properties of materials.
LO7. Prepare a test report from the laboratory.

TEACHERS

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MODULE CONTENT

LECTURE		hours
L 1-4	– Internal forces, internal forces diagrams.	4
L 5-8	– Moment of inertia of a plane area, polar moment of inertia, product of inertia, Steiner theorem.	4
L 9-10	– Principal central moments of inertia, central principal axes.	2
L 11-12	– Tension and compression, normal stress and strain, stress-strain diagrams, Hooke's Law, Young's modulus.	2
L 13-14	– Stress and strain tensor, constitutive relations.	2
L 15-16	– Shear stress and strain, pure shear, shear modulus – modulus of rigidity, shear stress in beams.	2
L 17-18	– Torsion of round shafts, stress in torsion, relation between Young's and shear modulus, section modulus.	2
L 19-22	– Stress in pure bending, curvature of beams, combined stress – bending and tension or compression, normal stress diagrams, axial section modulus, eccentric compression or tension.	4
L 23-26	– Strength hypotheses, maximum shear stress theory, strain energy of distortion theory.	4
L 27-28	– Compound stresses, permissible stress.	2
L 29-30	– Deformation of beams.	2
	total	**30**

TUTORIALS		hours
T 1,2	– Internal forces, internal forces diagrams.	2
T 3-5	– Moment of inertia of a plane area, polar moment of inertia, product of inertia, Steiner theorem. Principal central moments of inertia, central principal axes.	3
T 6-8	– Stress in pure bending, combined stress – bending and tension or compression, normal stress diagrams, eccentric compression or tension.	3
T 9,10	– Shear stress, Żurawski formula.	2
T 11	– Torsion of round shafts. Torsional moments, shear stress due to torsion.	1
T 12-13	– Compound stress, bending and torsion of round shafts, bending and shear in beams.	2
T 14	– Design criteria.	1
T 15	– Deformation of beams due to bending, Clebsch method.	1
	total	**15**

LABORATORY		hours
Lab 1-3	– Brinell and Poldi hardness tests.	3
Lab 4-6	– Rockwell and Vickers hardness tests.	3
Lab 7-8	– Measurement of impact strength of metals.	2
Lab 9-11	– Tension test using Zwick/Roell materials testing machine.	3
Lab 12-14	– Compression test using Zwick/Roell materials testing machine.	3
Lab 15-16	– Measurement of stress with bond wire strain gauges.	2
Lab 17-18	– Measurement of deflection in straight beams	2
Lab 19-20	– Bending test using Zwick/Roell materials testing machine.	2
Lab 21-30	– Computer modelling of deformation and stress in beams using Abaqus/FEA.	10
	total	**30**

TEACHING TOOLS

1 - lecture with the use of multimedia presentations and computer equipped with the proper software including Abaqus/FEA.
2 – laboratories equipped with measuring apparatus and computer software
3 – Instructions for laboratory classes and templates of test reports

SOURCE LITERATURE

1. Hearn E.J., Mechanics of Materials, 2nd Edition, 1985, Pergamon Press, Oxford, reprinted 1992, Vol1, 2
2. James M. Gere, Stephen P. Timoshenko: "Mechanics of Materials", 3rd Edition 1991, Chapman and Hall, London, reprinted 1993
3. Peter P. Benham, Robert J. Crawford, „Mechanics of Engineering Materials" 2nd Edition, 1988, Longman Scientific and Technical, John Wiley and Sons, Singapore
4. Beer F., Johnston E., DeWolf J., Mechanics of Materials 4th Edition in SI Units, 2006, McGraw and Hill, Singapore
5. Z.Dyląg, A.Jakubowicz, Z.Orłoś: Wytrzymałość materiałów. Tom 1, WNT, W-wa 2003
6. Z.Dyląg, A.Jakubowicz, Z.Orłoś: Wytrzymałość materiałów. Tom 2, WNT, W-wa 2003
7. M.E.Niezgodziński, T.Niezgodziński, Zadania z wytrzymałości materiałów, WNT, Warszawa, 1997
8. M.Banasiak, K.Grossman, M.Trombski, Zbiór zadań z wytrzymałości materiałów, PWN, 1998