AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Strength of materials

Academic year: 2013/2014 Code: RMS-1-304-s ECTS credits: 6

Faculty of: Mechanical Engineering and Robotics

Field of study: Mechatronics with English as instruction languagege Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 3

Course homepage: —

Responsible teacher: prof. dr hab. inż. Pęcherski Ryszard (rpe@agh.edu.pl)

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Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student is aware of the necessity of team work as well as of the economical and legal concequences of the reached decisions.	MS1A_W17, MS1A_W15, MS1A_W18	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes
Skills			
M_U001	Student is able to apply the design concepts for simple and complex cases of stress state.	MS1A_W02, MS1A_W01, MS1A_W08	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes
M_U002	Student is able to assess the risk of the assumed simplifications in the design procedures.	MS1A_W02, MS1A_W01, MS1A_W08	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes
Knowledge			

M_W001	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.	MS1A_W02, MS1A_W01, MS1A_W08	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes
M_W002	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).	MS1A_W02, MS1A_W01, MS1A_W08	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes
M_W003	Student knows how to apply the design concepts and formulas of strength of materials for practical cases of mechanical engineering.	MS1A_W02, MS1A_W01, MS1A_W08	Activity during classes, Examination, Test, Oral answer, Report, Execution of exercises, Execution of laboratory classes

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Others	Fieldwork classes	Workshops	E-learning
Social competence												
M_K001	Student is aware of the necessity of team work as well as of the economical and legal concequences of the reached decisions.	-	-	-	-	-	-	-	-	-	-	-
Skills												
M_U001	Student is able to apply the design concepts for simple and complex cases of stress state.	-	+	+	-	-	-	-	-	-	-	-
M_U002	Student is able to assess the risk of the assumed simplifications in the design procedures.	-	+	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	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.	+	+	-	-	-	-	-	-	-	-	-

M_W002	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).	+	+	-	-	-	-	-	-	-	-	-
M_W003	Student knows how to apply the design concepts and formulas of strength of materials for practical cases of mechanical engineering.	+	+	-	-	-	-	-	-	-	-	-

Module content

Lectures

List of lecture topics

1 Introduction
2 Internal forces and cross-sectional forces
3 State of stress analysis in a point. A plane state of stress.
4 Strain analysis. Generalized Hooke’s law for isotropic materials
5 Problems of strength of a prismatic bar. The problem of a pure and simple tension/compression
6 Pure and simple torsion, torsion of a bar with circular cross-section
7 Pure and simple bending, unsymmetric bending
8 Non-uniform bending, shear stress in beams.
9 Bending due to eccentric load.
10 Beam deflection.
11 Assessment of strength under complex load – failure theories
12 Elastic energy, a concept of material effort, hypotheses of material effort.
13 Buckling.
14 Some problems of the strength of materials related with engineering applications – assessment of strength in creep, brittle fracture and fatigue.

Auditorium classes

List of topics of auditorium classes

1 Geometrical characteristics of cross-sections.
2 Review of statics. Cross-sectional forces – normal, shear and moment functions.
3 State of stress and strain. A plane state of stress.
4 Strain state, application of Hooke’s law.
5 Axial tension/compression.
6 Torsion of circular cross-sections.
7 Bending – simple and unsymmetric.
8 Joining of structural elements – shear problems.
9/10 Stress and strain – structural problems. Knowledge checking.

Laboratory classes

Non-destructive tests

Non-destructive tests – theoretical introduction
Non-destructive tests – laboratory classes

Investigations of mechanical properties of materials
Mechanical properties of materials – Part 1 (tensile and compressive strength)- laboratory classes
Mechanical Properties of Materials – Part 2 (toughness and hardness)- laboratory classes

Analysis of the states of stress and strain
Stress and strain state analysis (Finite Element Method) – laboratory classes

Photoelasticity
Photoelasticity – laboratory classes

Strain-gauge measurements
Strain-gauge measurements – theoretical introduction,
Strain-gauge measurements – laboratory classes

Method of calculating the final grade

Final mark is the average of the exam, laboratories and auditorium classes.•
Mark from laboratories:
The average of all laboratory exercises (short tests and reports).
Mark from auditorium classes:
• Class attendance is obligatory.
• During the classes, a student will write short tests evaluated 0/1 point and will answer orally to the evaluation 0/0.5 point. The average of accumulated points obtained from short tests and answers will be the basis for the mark from auditorium classes:
50% of possible points – 2.0
50%-60% of possible points – 3.0
61%-70% of possible points – 3.5
71%-80% of possible points – 4.0
81%-90% of possible points – 4.5
91%-100% of possible points – 5.0
• If a student fails auditorium classes (mark 2.0), they will have a possibility of a resit in the form of a resit test. In the resit test there will be 5 tasks evaluated as follows:
0 point – if wrong or a major mistake;
0.5 point – a minor error in calculations;
1 point – task solved properly.
The mark from the resit test will be assigned according to the following scale:
50% of possible points – 2.0
50%-60% of possible points – 3.0
61%-70% of possible points – 3.5
71%-80% of possible points – 4.0
81%-90% of possible points – 4.5
91%-100% of possible points – 5.0

Prerequisites and additional requirements

1. The following courses have to be passed with a positive mark: Mathematics, Mechanics 1.
2. Students should have knowledge of vectors: forces, moments, system of forces reduction.
3. Students should know how to calculate static reactions of statically determinate structures.
4. Students should know basics of mathematical analysis: differentials, integrals.

Recommended literature and teaching resources

1. Timothy A. Philpot, Mechanics of Materials, John Wiley & Sons, 2008.
2. James M. Gere, Stephen P. Timoshenko, Mechanics of Materials, ITP Co., Boston, 1997.
3. Piechnik S. “Mechanika techniczna ciała stałego”, Wydawnictwo PK, Kraków 2007
4. Wolny S., Siemieniec A. “Wytrzymałość materiałów. Część I.”, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków 2008
5. Niezgodziński A., Niezgodziński T. “Zadania z wytrzymałości materiałów”, Wydawnictwo WNT,

Warszawa 2012
6. Bodnar A. „Wytrzymałość materiałów. Podręcznik dla studentów wyższych szkół technicznych”, wydanie drugie poszerzone i poprawione, Kraków 2004
7. Wolny S., Siemieniec A. “Wytrzymałość materiałów. Część IV Ćwiczenia laboratoryjne”, Uczelniane Wydawnictwa Naukowo-Dydaktyczne AGH, Kraków 2008

Scientific publications of module course instructors related to the topic of the module
Additional scientific publications not specified

Additional information
None

Student workload (ECTS credits balance)

Student activity form	Student workload
Contact hours	2 h
Participation in laboratory classes	14 h
Preparation for classes	56 h
Participation in auditorium classes	20 h
Participation in lectures	28 h
Realization of independently performed tasks	25 h
Examination or Final test	15 h
Summary student workload	160 h
Module ECTS credits	6 ECTS