COURSE INFORMATION SHEET
(KARTA INFORMACYJNA PRZEDMIOTU)

Course title (Nazwa przedmiotu)	***Strength of Materials 2***	***Wytrzymałość materiałów 2***
Course code (Kod przedmiotu)	*WMEMXCNI-SM*	
Language of instruction (Język wykładowy)	*english (angielski)*	
Study profile (Profil studiów)	*general academic (ogólnoakademicki)*	
Study form (Forma studiów)	*part-time studies (niestacjonarne)*	
Study level (Poziom studiów)	*first-cycle studies (studia pierwszego stopnia)*	
Course group (Rodzaj przedmiotu)	*core / mandatory (podstawowy / obowiązkowy)*	
Effective from recruitment (Obowiązuje od naboru)	*2023 / 2024*	
Form of classes, no. of hours/ evaluation, total no. of hours, ECTS credits (Forma zajęć, liczba godzin/rygor, razem godz., pkt ECTS)	*Lectures 10/x* *Practical classes 12/+* *Laboratory exercises 4/z* ***Total: 26 hrs, 3 ECTS pts***	
Introductory courses: prerequisites (Przedmioty wprowadzające: wymagania wstępne)	*Mathematics: vectors; differential equations; derivatives and integrals of one variable.* *Engineering Mechanics 1: planar and spatial load systems, reduction and equilibrium of load systems, friction in planar systems, determination of reactions in planar and spatial systems.* *Engineering Mechanics 2: kinematics of points and rigid bodies.* *Strength of Materials 1: geometrical properties of planar figures, internal loads in bars, beams, plane and spatial frames, fundamentals of the strength of materials, tension and compression of stocky bars, torsion of bars and rods.*	
Programme (Program)	*4th semester / mechanical engineering / all specializations*	
Author(s) (Autor/autorzy)	*dr inż. Piotr SZURGOTT*	
Organizational unit administering the course (Jednostka organizacyjna odpowiedzialna za przedmiot)	*Institute of Mechanics and Computational Engineering* *Faculty of Mechanical Engineering* *Military University of Technology*	
Short descriptions of the course (Skrócony opis przedmiotu)	*Simple bending of beams. State of stress and state of strain. Hooke's law for an isotropic material. Combined loadings. Application of the principle of virtual work to determine displacements. Statically indeterminate beams and plane frames. Buckling of straight slender bars.*	
Full description of the course / programme content Pełny opis przedmiotu / treści programowe	*Lectures / multimedia presentations* 1. ***Simple bending of beams / 2 hrs /*** *State of strain and stress. Section modules of selected cross-sections. Designing. Shear in bending beams. Shear stress distribution for different section. Beam deflection curve. Double integration method. Clebsch method. Examples.* 2. ***State of stress and state of strain / 1 hr /*** *Spatial and plane states of stress: stress transformation, principal directions and principal stresses, special cases. Spatial and plane states of strain: strain transformation, principal directions and principal strains, special cases. Strain measurements.* 3. ***Hooke's law for an isotropic material / 1 hr /*** *Three-dimensional form of Hooke's law. Standard and inverse Hooke's law. Special cases. Examples.* 4. ***Combined loadings / 2 hrs /*** *Stress hypothesis for isotropic material. Synthesis of simple strength cases. Bending with shear. Diagonal bending. Eccentric tension. Tension with torsion. Tension with bending. Bending with torsion. Examples.* 5. ***Application of the principle of virtual work to determine displacements / 2 hrs /*** *Assumptions. State of displacement and state of load. The principle of virtual work. Formulas for determining displacements. Mohr integrals.* 6. ***Statically indeterminate beams and plane frames / 1 hr /*** *Formulation of the force method. Basic schemes. Determination of displacements. Examples* 7. ***Buckling of straight slender bars / 1 hr /*** *Buckling phenomenon. Solving the basic task. Critical forces. Critical stresses. Principles of strength calculations. Examples.*	

	Practical classes / arithmetic exercises *1. Stress analysis and design of bending beams / 2* *2. Combined loadings / 2* *3. Application of the principle of virtual work to determine displacements / 2* *4. Solving statically indeterminate beams and plane frames using the force method / 2* *5. Test #1: Stress analysis and design of bending beams / 1* *6. Test #2: Combined loadings / 1* *7. Test #3: Application of the principle of virtual work to determine displacements in beams / 1* *8. Test #4: Solving statically indeterminate beams using the force method / 1* *Laboratory exercises / laboratory of experimental research* *1. Static tensile test of metals. Strict tensile testing of metals. Determination of shear modulus. Torsion of a bar with a rectangular cross-section. / 2* *2. Static compression test of metals. Determination of stresses in a bending beam using the strain gauge method. Experimental checking of Maxwell's theorem. / 2*
Literature (Literatura)	*Primary:* Klasztorny M.: *Wytrzymałość materiałów dla mechaników. Kurs inżynierski*, DWE, 2013. Gieleta R.: *Zadania z wytrzymałości materiałów z rozwiązaniami*, WAT, 2018. Dyląg Z., Jakubowicz A., Orłoś Z.: *Wytrzymałość materiałów, t. 1, 2*, WNT, 1997. *Complementary:* Bansal R.K.: *A Textbook of Strength of Materials*, Laxmi Publications Ltd., New Dehli, India 2015.
Learning outcomes (Efekty uczenia się)	*Symbol and number of the course outcome / learning outcomes / reference to the major outcome* ***W1** / has knowledge of the strength of materials, including simple bending of beams, combined loadings in bars, states of stress and strain, application of the principle of virtual work to determine displacements, the force method, buckling of slender bars / K_W01, K_W02, K_W05* ***U1** / is able to solve simple strength problems in the field of simple bending of beams, combined loadings in bars, the application of the principle of virtual work to determine displacements, the force method, based on the principles of strength of materials / K_U07, K_U09* ***K1** / understands the need and knows the possibilities of continuous education; can inspire and organize the process of improving own's and other people professional qualifications / K_K01*
Methods and criteria of evaluation / manners of verification the student's achievement of the assumed learning outcomes (Metody i kryteria oceniania / sposób sprawdzania osiągnięcia przez studenta zakładanych efektów uczenia się)	*The course is credited based on: **final exam**.* *Practical classes are credited based on: **tests and homeworks**.* *Laboratory exercises are passed on the basis of: **tests of theoretical knowledge and reports**.* *The condition for admission to the final exam is: **passing the practical classes and laboratory exercises.*** *The final exam is conducted in a written form and includes a practical part (problem solving) and a theoretical part (quiz).* *The grade in the exam is independent of the grade in the practical classes and laboratory exercises.* *The achievement of **W1** learning outcome is verified based on the theoretical part of the final exam.* *The achievement of **U1** learning outcome is verified based on the practical part of the exam, tests during practical classes and homeworks.* *The achievement of **K1** learning outcome is effected based on students' activity.* *Assessment of the achieved learning outcomes (according to opinion of the Facullty Commission for the Functioning of the Education Quality Assurance System):* *Very good (A) – grade awarded to students who achieved 91-100% of the learning outcomes.* *Good plus (B) – grade awarded to students who achieved 81-90% of the learning outcomes.* *Good (C) – grade awarded to students who achieved 71-80% of the learning outcomes.* *Satisfactory plus (D) – grade awarded to students who achieved 61-70% of the learning outcomes.* *Satisfactory (E) – grade awarded to students who achieved 51-60% of the learning outcomes.* *Unsatisfactory (F) – grade awarded to students who achieved 50% of the learning outcomes or less.* *PASS – grade awarded to students who achieved more than 50% of the learning outcomes.* *FAIL – grade awarded to students who achieved 50% of the learning outcomes or less.*

ECTS balance / student workload (Bilans ECTS / nakład pracy studenta)	*Activity / student workload in hrs* *1. Participation in lectures / **10*** *2. Participation in practical classes / **12*** *3. Participation in laboratories / **4*** *4. Participation in seminars / **0*** *5. Independent study of the lectures subject-matter / **16*** *6. Independent preparation for practical classes / **36*** *7. Independent preparation for laboratories / **12*** *8. Independent preparation for seminars / **0*** *9. Project implementation / **0*** *10. Participation in consultations / **3.9*** *11. Preparation for the exam / **10.4*** *12. Preparation for the credit / 0* *13. Participation in the exam / **2*** *Total student workload: **106.3 hrs** / 3.54 ECTS, **3 ECTS** assumed* *Classes with academic teacher (1+2+3+4+9+10+13): **31.9 hrs / 1.5 ECTS*** *Classes related to scientific skill development (Σ1÷9): **90 hrs / 2 ECTS***