GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechanics of materials and biomaterials, PG_00065006		
Field of study	Mechanical and Medical Engineering		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Applied Mechanics and Biomechanics -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Wiktoria Wojnicz	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	11.0	44.0	100

Subject objectives

Acquiring knowledge and skills of solving advanced problems of mechanics of materials and biomaterials

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K13] is ready for responsible performance of proffesional roles, considering ever-changing need of the society, including self developement and supporting and fullfiling work ethics	A student define a strategy that allows acquiring knowledge related to the mechanical-medical engineering to solve a problem by considering changing social needs	[SK2] Assessment of progress of work [SK5] Assessment of ability to solve problems that arise in practice
[K7_K11] is aware of importance of professional acting, the need for critical verification of acquired knowledge and consulting experts opinion in case of facing difficulties with individual problem solving	To solve a given problem a student applies advanced knowledge related to the mechanical-medical engineering by considering the need to verify the current level of this knowledge on the base of teaching and scientific publications	[SK2] Assessment of progress of work [SK5] Assessment of ability to solve problems that arise in practice
[K7_W04] has structured and well-founded knowledge covering issues in the field of mechanical engineering allowing to design medical devices, rehabilitation systems and to formulate research procedures	To design a medical device a student formulates research procedure and stages of developing of medical device (or rehabilitation systems) on the base of knowledge related to mechanical-medical engineering	[SW2] Assessment of knowledge contained in presentation

Subject contents	**Lectures (DSc PhD Wiktoria Wojnicz) (30h):** Tensor calculation fundamentals. Fundamentals of elasticity theory: 3D stress state, Navier equation, boundary task in stress state and in the displacement state. Fundamentals of elasticity theory; 3D strain state, constitutive relations. Analysis of strain state by using strain gauge systems. Deformable body mechanics: strain tensors. Material models: orthotropic materials. Modele materiałowe: modele stosowane do opisywania biomateriałów (w tym miękkich). Fundamentals of composite materials modelling. Finite Element Method (FEM) in engineering calculations: fundamental definitions. FEM: Truss element, Beam element, Membrane element. Podstawy teorii plastyczności . Wytrzymałość prętów sprężysto-plastycznych. Fatigue strength. Fracture mechanics. Contact stress. Fundamentals of rheology. Thin-walled structure in engineering calculations. Centre of shear estimation. **Lab (PhD Alicja Stanisławska) (15h):** Estimation of hardness, reduced Youngs modulus, yielding strength and elastic strength in nanoindentation test. Estimation of type and value of internal stress in tested material. Fracture mechanics. Assessment of stress intensity factor. Testing of strain rate during the creep of material. Testing of hardness by using Brinell, Rockwell and Vickers methods. Testing of impact strength of metallic sample coved by the oxygen layer.

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<tr><td>Prerequisites and co-requisites</td><td colspan="3">Skills on formulation of the static equilibrium conditions and dynamic equations. Skills on solution of ordinary and partial differential equations. Knowledge on Mathematics, Mechanics and Strength of Materials.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Laboratory</td><td>50.0%</td><td>30.0%</td></tr>
<tr><td>Written exam</td><td>50.0%</td><td>70.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Bąk R., Burczyński T.: Wytrzymałość materiałów z elementami ujęcia komputerowego. Warszawa, WNT, 2001.

2. Banasiak M., Grossman K., Trombski M.: Zbiór zadań z wytrzymałości materiałów. PWN, Warszawa, 1998.

3. Ostrowska-Maciejewska J., Kowalczyk-Gajewska K.: Rachunek tensorowy w mechanice ośrodków ciągłych. Warszawa, Wydawnictwo IPPT, 2013.

4. Sawicki A.: Mechanika kontinuum. Wprowadzenie. Gdańsk: Wydaw. Instytutu Budownictwa Wodnego PAN 1994.

5. Wojnicz W., Wittbrodt E.: Mechaniczne Metody Badań Materiałów. Wydawnictwo Politechniki Gdańskiej, 2020, ISBN 978-83-7348-810-6</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. Gawęcki A.: Mechanika materiałów i konstrukcji prętowych. Poznań: Wyd. Politechniki Poznańskiej 1998.
2. Rymarz Cz.: Mechanika ośrodków ciągłych. Warszawa: Wydaw. Naukowe PWN 1993.
3. Kaliński K. J.: Nadzorowanie procesów dynamicznych w układach mechanicznych. Gdańsk: Wydaw. Polit. Gdańskiej 2012.</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Describe parameters of stress state and stress state of isotropic materials and orthotropic materials</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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