COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S2-ME-EM-113**
	part-time programme:	
Course title in Polish	**Tribologia i tribotechnika**	
Course title in English	**Tribology and Tribotechnology**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**second-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**Machine Operation and Maintenance**
Department responsible	**Department of Maintenance, Laser and Nanoscale Technologies**
Course leader	**dr hab. inż. Monika Madej, prof. PŚk**
Approved by	**dr hab. Jakub Takosoglu, prof. PŚk, Dean of the Faculty of Mechatronics and Mechanical Engineering**

COURSE OVERVIEW

Course type		**specialism-related**
Course status		**compulsory**
Language of instruction		**English**
Semester of delivery	full-time programme	**Semester I**
	part-time programme	**Semester I**
Pre-requisites		
Examination required (YES/NO)		**NO**
ECTS value		**3**

Mode of instruction		**lecture**	**class**	**laboratory**	**project**	**seminar**
No. of hours per semester	full-time programme	**15**		**30**		
	part-time programme					

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	Has knowledge of manufacturing technology to shape the structure and properties of engineering materials.	MiBM2_W05
	W02	Has knowledge of the operation and wear of machine and device elements. Is able to characterize the operation of mechanical systems.	MiBM2_W07
	W03	Has knowledge of modern engineering materials. Is able to select research methodology to assess the mechanical and tribological properties of engineering materials.	MiBM2_W08
	W04	Has knowledge of surface engineering (including: modeling the surface layer, assessment of the condition and durability of the surface).	MiBM2_W11
Skills	U01	Can use Polish and foreign literature and acquire knowledge from other sources.	MiBM2_U03
	U02	Can organize a work station, operate devices, equipment and machines in accordance with applicable safety rules.	MiBM2_U10
	U03	Can select the appropriate material for the operational function performed, classify wear processes and methods of minimizing them.	MiBM2_U12
	U04	Can work individually and in a group, act in a creative and enterprising manner.	MiBM2_U15
Competence	K01	Is aware of the need for personal development and understands the need to constantly supplement knowledge in materials science in order to improve professional qualifications.	MiBM2_K01
	K02	Is aware of the consequences of engineering activities, their impact on the environment, and the associated responsibility for decisions made.	MiBM2_K02

COURSE CONTENT

Mode of instruction	Topics covered
lecture	Definition of tribology and tribotechnics. Basic information about friction, wear and lubrication. Study of friction and wear of friction nodes in tribological systems. Definition of the operating process. Characteristics and operation of mechanical systems. Machine service life. Monitoring of mechanical systems with particular emphasis on tribological systems - a system of laboratory and operational tests. Monitoring of operating materials. Temporary protection agents; corrosion and protection against corrosion. Water and aqueous solutions. Metalworking fluids and hydraulic fluids. Lubricants for industry. Plastic greases and special purpose greases. Additives modifying lubricants. Anti-wear layers and coatings obtained by PVD, CVD, ALD methods. Tribological properties of material associations used in industry. The influence of external influences on friction and the wear process of machine and device elements. Practical application of tribological knowledge in the design, production and operation of industrial machines and devices. Tribo-engineering of surfaces.

laboratory	Determination of hardness, conductivity and hydrogen ion concentration exponent in water with different parameters. Study of properties of water-based operating fluids used in industry. Basic methods and equipment for tribological tests on micro and nano scale. Evaluation of tribological properties of conventional lubricants used in the machine industry. The influence of modifying additives on the properties of lubricants used in machines and devices. Electrochemistry. Corrosion and corrosion protection. Microscopic analysis of wear of working elements in a real system. Selection of parameters for manufacturing anti-wear, low-friction surface layers and coatings using vacuum techniques for applications in mechanics and machine construction.

ASSESSMENT METHODS

Outcome code	Methods of assessment					
	Oral examination	Written examination	Test	Project	Report	Other
W01			X			
W02			X			
W03			X			
W04			X			
U01			X		X	
U02			X		X	
U03			X		X	
U04					X	
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	Achieving at least 50% of points in the final test
laboratory	non-examination assessment	Achieving at least 50% of points in the final test

OVERALL STUDENT WORKLOAD

ECTS weighting

No.	Activity type	Student workload										Unit
		full-time programme					part-time programme					
1.	Scheduled contact hours	L	C	Lb	P	S	L	C	Lb	P	S	h
		15		**30**								
2.	Other contact hours (office hours, examination)	**2**		**2**								h
3.	**Total number of contact hours**	**49**										h
4.	**Number of ECTS credits for contact hours**	**2,0**										ECTS
5.	**Number of independent study hours**	**26**										h
6.	**Number of ECTS credits for independent study hours**	**1,0**										ECTS
7.	**Number of practical hours**	**50**										h
8.	**Number of ECTS credits for practical hours**	**2,0**										ECTS
9.	**Total study time**	**75**										h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**3**										ECTS

READING LIST

1. Mądziel M., Nanotechnology as a future of road transport development. Autobusy, 17, 12, 2016.
2. Li H., Lv S., Fang Y.: Bio-inspired micro/nanostructures for flexible and stretchable electronics. Nano Research, 13(5): 1244–1252, 2020.
3. Stachowiak G. W., Batchelor A. W. Engineering Tribology, Elsevier Butterworth-Heinemann, 2005.
4. Totten G. E., Handbook of Lubrication and Tribology, Taylor & Francis, Boca Raton, London, New York, 2006.
5. Davim P. J., Tribology for Engineers: A Practical Guide, Woodhead Pub, 2011.
6. Maaß P., Chapter 1 Corrosion and Corrosion Protection in Handbook of Hot-Dip Galvanization, Wiley-VCH Verlag GmbH & Co. KGaA, 2011.
7. Yanguas-Gil A., Growth and Transport in Nanostructured Materials. Reactive Transport in PVD, CVD, and ALD, Springer, 2017.
8. Dresel W., Mang T., Lubricants and Lubrication, Third, Completely Revised and Enlarged Edition, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany, 2017.
9. Torbacke M., Rudolphi A, K., Kassfeldt E., Lubricants: Introduction to Properties and Performance, John Wiley & Sons, Chichester, 2014.