COURSE SPECIFICATION

Course code	full-time programme:	**M#2-S1-ME-KWW-509**
	part-time programme:	
Course title in Polish	**Obróbka plastyczna**	
Course title in English	**Metal forming**	
Valid from (academic year)	**2024/2025**	

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time programme**
Specialism	**Computer-Aided Manufacturing**
Department responsible	**Department of Metal Science and Manufacturing Processes**
Course leader	**dr inż. Tomasz Miłek**
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 V**
	part-time programme	
Pre-requisites		**Fundamentals of Metal Forming**
Examination required (YES/NO)		**NO**
ECTS value		**2**

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

LEARNING OUTCOMES

Category of outcome	Outcome code	Course learning outcomes	Corresponding programme outcome code
Knowledge	W01	Having successfully completed this course, students will have knowledge of metal forming processes, they will know and understand manufacturing processes used to manufacture mechanical elements with special tooling and equipments	MiBM1_W06 MiBM1_W07
	W02	By the end of this course, student will have knowledge and will understand the influence of different factors on the suitability of metal sheets for forming processes of elements used in the construction of machines and devices.	MiBM1_W06 MiBM1_W07
Skills	U01	On completion of this programme students will be able to obtain information from the literature, databases and other sources in various languages; they will be able to combine, analyze and interpret the information, draw conclusions and formulate and justify opinions	MiBM1_U03
	U02	On completion of the course, student will be able to develop technical documentation required for an engineering task and write a report discussing the results	MiBM1_U04
Competence	K01	Students are aware of the need to critically assess and update their expertise from metal forming and by exchanging knowledge and experiences with other metal forming experts	MiBM1_K01
	K02	Students are able to individually supplement and broaden their knowledge in the area metal forming	MiBM1_K03

COURSE CONTENT

Type of instruction lecture	Topics covered
lecture	Introduction to determination of formability of sheet-metal: discussion of the most important of material properties that may affect the drawability of the sheet, the flow stress characteristics as a function of the strain rate, influence of mechanical properties on formability. Discussion of mechanical anisotropy: normal and planar anisotropy (definitions, schematic representations, Lankford factor, Keller coefficient, an average value of normal anisotropy for sheets, calculations of limit coefficient of deep drawing processes), influence of anisotropy on drawability of material. Sheet metal formability tests, discussion of selected methods for determine the suitability of sheet metals for forming processes: strech-forming test (Erichsen cupping test) and deep drawing test (Engelhardt method); definitions, schemes, characteristic parameters from tests, comparison of formability of sheet-metal for different materials. Discussion of selected methods of shaping of draw pieces on presses: ironing, flanging, sizing, necking and bulge forming processes (definitions, schemes, calculation of deformations degrees, technological parameters, applications, advantages and disadvantages). Discussion of methods of draw pieces forming with high wall-thickness reduction and with thick bottom (schemes, definitions and applications) Forming methods of drawpieces.

laboratory	Introduction to laboratory class. Cutting of bars using sleeve knifes Swinging pressing Shaft reduction Making splines Ironing Cold pipe bending

ASSESSMENT METHODS

Outcome code	Methods of assessment *(Mark with an X where applicable)*					
	Oral examination	Written examination	Test	Project	Report	Other
W01			X			
W02			X			
U01					X	
U02					X	
K01						X
K02						X

ASSESSMENT TYPE AND CRITERIA

Mode of instruction	Assessment type	Assessment criteria
lecture	non-examination assessment	The pass mark is a minimum of 50% for the final in-class test
laboratory	non-examination assessment	Regular class attendance. A minimum of 50% for the final in-class test. A pass mark for each post-lab report.

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		15								
2.	Other contact hours (office hours, examination)	2		2								h
3.	**Total number of contact hours**	**34**										h
4.	**Number of ECTS credits for contact hours**	**1,4**										ECTS
5.	**Number of independent study hours**	**16**										h
6.	**Number of ECTS credits for independent study hours**	**0,6**										ECTS
7.	**Number of practical hours**	**25**										h
8.	**Number of ECTS credits for practical hours**	**1,0**										ECTS

9.	**Total study time**	**50**		h
10.	**ECTS credits for the course** *1 ECTS credit = 25-30 hours of study time*	**2**		ECTS

READING LIST

1. Instructions for laboratory exercises
2. Erbel J i inni.: Encyclopedia of manufacturing techniques used in the engineering industry. T 1, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001 (in Polish).
3. Sińczak J. i inni: Metal forming processes. Laboratory exercises. Wydawnictwo naukowe AKA-PIT, Kraków 2001 (in Polish).
4. Lange K: Handbook of metal forming, MCGraw-Hill Book Company
5. Pacanowski J.: Design of deep drawing process of axisymmetric drawpieces and design press-forming dies T1 Methods and directives for deep drawing of axisymmetric drawpieces, Kielce: Kielce University of Technology, 2018 (in Polish)
6. Pacanowski J., Chałupczak J.: Design of die forging processes of circular-symmetric elements on presses and hammers Politechnik Świętokrzyska. Kielce, 2011(in Polish)
7. Golatowski T.: Design of deep drawing process and press-forming dies Selected problems. Warsaw: Warsaw University of Technology, 1984 (in Polish)
8. Marciniak Z Limit strains in deep drawing process of sheet metals, Warsaw: WNT, 1971 (in Polish)
9. Richert J.: Innovative methods of metal forming processes. Wydawnictwa AGH 2010 (in Polish).
10. Żaba K., Mamala A.: Metal forming of non-ferrous metals. Laboratory exercises. Rolling and drawing. Wydawnictwa AGH, Kraków 2011 (in Polish).
11. Miłek T.: Techniques of production. Kielce University of Technology, Kielce 2012 (www.wmibm-moodle.tu.kielce.pl)