Kielce University of Technology

FACULTY OF MECHATRONICS AND MECHANICAL ENGINEERING

Annex 9
to the Rector's Ordinance No. 35/19
of 12 June 2019

COURSE SPECIFICATION

Course code	**M#1-S1-ME-KWW-508**
Course title in Polish	**Obróbka plastyczna**
Course title in English	**Metal Forming**
Valid from (academic year)	**2019/2020**

GENERAL INFORMATION

Programme of study	**MECHANICAL ENGINEERING**
Level of qualification	**first-cycle**
Type of education	**academic**
Mode of study	**full-time**
Specialism	**Computer-Aided Manufacturing**
Department responsible	**Department of Metal Science and Manufacturing Processes**
Course leader	**Tomasz Miłek, Ph. D.**
Approved by	

COURSE OVERVIEW

Course type	**programme-specific**
Course status	**compulsory**
Language of instruction	English
Semester of delivery	**semester 5**
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	**15**		**15**		

LEARNING OUTCOMES

Category of outcome	Out-come 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.	MiBM_W10
	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 de-vices.	MiBM_W11
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, analyse and interpret the information, draw conclusions and formulate and justify opinions	MiBM1_U03
	U02	On completion of the course, student will be able to de-velop technical documentation required for an engineer-ing task and write a report discussing the results	MiBM1_U04
Competence	K01	By the end of this course, students will be aware of the responsibility for their professional engagement and are ready to comply with the principles of team work, taking the responsibility for tasks performed as a team.	MiBM1_K04

COURSE CONTENT

Type of instruction*	Topics covered
lecture	1. 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 proper-ties on formability.
	2. Discussion of mechanical anisotropy: normal and planar anisotropy (definitions, schematic representations, Lankford factor, Keller coeffiction, an average value of normal anisotropy for sheets, calculations of limit coeffiction of deep drawing pro-cesses), influence of anisotropy on drawability of material.
	3. - 4. Sheet metal formability tests, discussion of selected methods for determine the suitability of sheet metals for forming processes: strech-forming test (Erichsen cup-ping test) and deep drawing test (Engelhardt method); definitions, schemes, charac-teristic parameters from tests, comparision of formability of sheet-metal for different materials.
	5. – 6. Discussion of selected methods of shaping of drawpieces on presses: ironing, flanging, sizing, necking and bulge forming processes (definitions, schemes, calcula-tion of deformations degrees, technological parameters, applications, advantages and disadvantages).
	7. Discussion of methods of drawpieces forming with high wall-thickness reduction and with thick bottom (schemes, definitions and applications)Forming methods of drawpieces
	8. Test
laboratory	1. Introduction to laboratory class
	2. Redrawing of drawpieces without collar
	3. Can backward extrusion
	4. Solid forward extrusion
	5. Flanging (collar drawing)

	6. Hydroforming
	7. Test

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

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								
	Activity type	Student workload					Unit
1.	Scheduled contact hours	L	C	Lab	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**					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. Erbel J i inni.: Encyclopedia of manufacturing techniques used in the engineering industry. T 1, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2001 (in Polish).
2. Sińczak J. i inni: Metal forming processes. Laboratory exercises. Wydawnictwo naukowe AKAPIT, Kraków 2001 (in Polish).

3. Lange K: Handbook of metal forming, MCGraw-Hill Book Company
4. 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)
5. Pacanowski J., Chałupczak J.: Design of die forging processes of circular-symmetric elements on presses and hammers Politechnik Świętokrzyska. Kielce, 2011(in Polish)
6. Golatowski T.: Design of deep drawing process and press-forming dies Selected problems. Warsaw: Warsaw University of Technology, 1984 (in Polish)
7. Marciniak Z Limit strains in deep drawing process of sheet metals, Warsaw: WNT, 1971 (in Polish)
8. Richert J.: Innovative methods of metal forming processes. Wydawnictwa AGH 2010 (in Polish).
9. Żaba K., Mamala A.: Metal forming of non-ferrous metals. Laboratory exercises. Rolling and drawing. Wydawnictwa AGH, Kraków 2011 (in Polish).
10. Miłek T.: Techniques of production. Kielce University of Technology, Kielce 2012 (www.wmibm-moodle.tu.kielce.pl)
11. Instructions for laboratory exercises.