

## SYLLABUS OF A MODULE

Polish name of a module	<b>Teoria procesów spawalniczych</b>
English name of a module	<b>Theory of welding processes</b>
ISCED classification - Code	0715
ISCED classification - Field of study	<i>Mechanics and metal trades</i>
Languages of instruction	<i>English</i>
Level of qualification:	<i>2 – MSc (EQF 7)</i>
Number of ECTS credit points	5
Examination:	<i>A - assignment</i>

### Number of hours per semester:

Lecture	Exercises	Laboratory	Seminar	E-learning	Project
30	15	15	0	0	0

## MODULE DESCRIPTION

### MODULE OBJECTIVES

- O1. Provide theory of the phenomena occurring in the welding arc and basics of the physio-chemical bonding process and effect of the heat flow during welding processes.
- O2. Acquisition by students practical skills of weldability assessment, selection of basic materials and additives for various bonding methods and skills of calculation of heat flow, stress and welding distortions of welded joints.

### PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Fundamentals of materials science.
2. Fundamental of basic welding techniques.
3. Ability to perform mathematical operations to solve given tasks.
4. Capability of using source literature.
5. Capability of individual work and collaboration in a group.
6. Data analysis and presentation of results.

### LEARNING OUTCOMES

- LO 1 – Knowledge concerning phenomena in the welding arc and metallurgical aspects of the welding.
- LO 2 – Knowledge of thermal cycle of welding and its effect on structure and behaviour of welded materials.
- LO 3 – Ability to calculate parameters of thermal cycle and assessment of the weldability .

## MODULE CONTENT

Type of classes – lecture	Number of hours
Lec 1-2 - Basics - classification and types of welding processes.	2
Lec 3-6 - Characteristics of the welding arc and the phenomena occurring in the welding arc.	4
Lec 7-8 – The types of welding sources used in welding.	2
Lec 9-11 - Basic issues related to the flow of heat in welding.	3
Lec 12-13 - Welding heat cycles – types and main parameters.	2
Lec 14-17 - Metallurgical phenomena occurring during the welding process.	4
Lec 18 -19 – Construction of welded joint – changes in the heat affected zone.	2
Lec 20-21 - The formation and the distribution of stresses in the welded joint.	2
Lec 22-23- Characteristics of welding distortions.	2
Lec 24-27 - Types and causes of cracks in welded joints.	4
Lec 28-30 - The concept of weldability, and methods of evaluation.	3
<b>Sum</b>	<b>30</b>
Type of classes– laboratory.	Number of hours
Exe 1-4 - Calculation of the characteristic values of the thermal cycle of welding	4
Exe 5-9 – Calculation of the stress and welding distortion in welding joints.	5
Exe 10-11 - Analytical methods for the evaluation of weldability	2
Exe 12-13 – Assessment of propensity to crack in welded joints.	2
Exe 14-15 – Calculation of preheating temperature for welded joints.	2
<b>Sum</b>	<b>15</b>
Type of classes– laboratory.	Number of hours
Lab 1-2 – Analysis of the types of material transport in welding arc.	2
Lab 3 - The evaluation of the arc blow effect	1
Lab 4 - Arc flexibility test	1
Lab 5-6 - Survey the effect of welding on the type and size of the welding distortion.	2
Lab 7-9 - Study of the effect of welding heat input on the hardness of the HAZ	3
Lab 10-11 - Experimental investigation of ability to brazing and soldering of different materials.	2
Lab 12-13 - Analysis of heating and cooling cycle of the basic materials used in welding	2
Lab 14-15 - Experimental analysis of processes of friction and electric resistance welding.	2
<b>Sum</b>	<b>15</b>

## TEACHING TOOLS

1 - lecture with the use of multimedia presentations
2 - experimental stands equipped with measuring instrumentation
3 - blackboard, calculator
4 - instructions to laboratory exercises

## WAYS OF ASSESSMENT ( F – FORMATIVE, S – SUMMATIVE

<b>F1.</b> - assessment of preparation for laboratory exercises
<b>F2.</b> - assessment of the ability to apply the acquired knowledge while doing the exercises
<b>F3.</b> - evaluation of reports on the implementation of exercises covered by the curriculum
<b>F4.</b> - assessment of activity during classes
<b>S1.</b> - assessment of the ability to solve the problems posed and the manner of presentation obtained results - pass mark *
<b>S2.</b> - assessment of mastery of the teaching material being the subject of the lecture - exam

\*) in order to receive a credit for the module, the student is obliged to attain a passing grade in all laboratory classes as well as in achievement tests.

## STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
<b>1. Contact hours with teacher</b>		
1.1	Lectures	30
1.2	Tutorials	15
1.3	Laboratory	15
1.4	Seminar	
1.5	Project	
1.6	Consulting teacher during their duty hours	5
1.7	Examination	
Total number of contact hours with teacher:		65
<b>2. Student's individual work</b>		
2.1	Preparation for tutorials and tests	15
2.2	Preparation for laboratory exercises, writing reports on laboratories	15
2.3	Preparation of project	
2.4	Preparation for final lecture assessment	15
2.5	Preparation for examination	
2.6	Individual study of literature	15
Total number of hours of student's individual work:		60
Overall student's workload:		125
<b>Overall number of ECTS credits for the module</b>		5 ECTS
Number of ECTS points that student receives in classes requiring teacher's supervision:		2,6 ECTS
Number of <b>ECTS</b> credits acquired during practical classes including laboratory exercises and projects:		1,2 ECTS

## BASIC AND SUPPLEMENTARY RESOURCE MATERIALS

1. Grong Ø.: Metallurgical modelling of welding. Michigan Institute of Materials, 1997
2. Granjon H.: Fundamentals of welding metallurgy. Abington Publishing ,1999
3. Hongyang Zang, Senkara J.: Resistance welding: Fundamentals and applications. Taylor&Francis Group, 2012
4. Feng Z.: Processes and mechanism of welding residual stress and distortion. Woodhead Publishing, 2005
5. Radaj D.: Heat Effects of Welding: Temperature Field, Residual Stress. Berlin Springer-Verlag, 1992
6. Radaj D.: Welding residual stresses and distortion : Calculation and measurement. Dusseldorf: Verlag feur Schweissen und verwandte Verfahren DVS-Verlag GmbH, 2003

## MODULE COORDINATOR (NAME, SURNAME, E-MAIL ADDRESS)

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