

13. Welding

GENERAL INFORMATION ABOUT THE COURSE		
Course coordinator	Ivan Samardžić, PhD, professor	
Course name	Welding	
Study program	Mechanical Engineering	
Course status	Compulsory / elective	
Year	1	
Semester	II	
Number of credits and teaching methods	ECTS student load coefficient	5
	Number of hours (lectures + seminars + exercises)	30 + 0 + 30

1. DESCRIPTION OF THE COURSE

1.1. Course objectives

Familiarising students with possible failures in welded joints and possibility of ensuring against failures. Examples of failure are elaborated upon and potential risks of failures are noted. Various types of examples of failures in welded products and structures in the country and abroad are noted and analysed, with the aim of identifying types and causes of failures, as well as activities that should be taken in order to ensure against failures. Errors in welded joints exist given that welding weakens the base metal. However, defects are those deviations that exceed the acceptance threshold and can be revealed using appropriate control methods. An overview is given of weakening mechanisms in welded joints, weakening factor for the base metal due to the presence of a welded joint, classes of welded joints and products, weldability and problems associated with the weldability of materials used in engineering practice. The weldability of a material is considered in terms of metallurgical, operational and structural weldability. Special emphasis is placed on condition and more difficult weldable materials and the welding of dissimilar materials.

1.2. Course enrolment prerequisites (*if applicable*)

There are no prerequisites for course enrolment

1.3. Expected course learning outcomes

1. Identify failures in welded joints and eliminating them.
2. Select the proper welding process.
3. Define the weldability of a material.
4. Define the welding of dissimilar materials.
5. Elaborate mechanisms involved in the weakening of welded joints.
6. Compare welding machines and their parts.

1.4. Course content							
<ol style="list-style-type: none"> 1. Introduction. Failures, reliability and classes of welded joints and products. 2. Effect of production, structural geometric defects on reliability. 3. Characterisation of defects during welding. 4. Possible failures of welded products. 5. Strength-stress model. 6. Classification of welded joints and welded products. 7. Weld joint coefficient-factor. Weakening of welds. Safety factor. 8. Static calculation of fillet weld based on IIW 9. The metallurgy of welding structural materials. 10. Schaeffler diagram. 11. Weldability of grey cast iron 12. The metallurgy of welding 13. Welding dissimilar materials 14. Apparatuses, mechanisation and automation in welding 15. Applying new production technologies in welding 							
1.5. Types of teaching	<input checked="" type="checkbox"/> Lectures <input type="checkbox"/> Seminars and workshops <input checked="" type="checkbox"/> Exercises <input type="checkbox"/> Distance learning <input checked="" type="checkbox"/> Field work			<input checked="" type="checkbox"/> Autonomous exercises <input type="checkbox"/> Multimedia and network <input checked="" type="checkbox"/> Laboratory <input type="checkbox"/> Mentor assistance <input type="checkbox"/> Other types			
1.6. Comments	<p>Classes take place in classrooms in the form of lectures, seminars and auditory exercises. Some of the exercises in the area of material weldability are conducted as laboratory exercises, demonstrating welding. Field classes lead to acquiring practical knowledge of welding technologies in practice (alloys, aluminium, copper, high-alloy steels, unalloyed steels, grey cast iron).</p>						
1.7. Student obligations (<i>attendance at classes, lectures, tutorials, seminars</i>)							
<ul style="list-style-type: none"> • Attending lectures and exercises • Active participation in classes • Solving problems in the area of material weldability 							
1.8. Tracking student work (proportion of individual activities in terms of ECTS credits based on the total number of ECTS credits)							
Class attendance	2	Class participation	-	Seminar paper	-	Experimental work	-
Written exam	1.5	Oral exam	1.5	Essay	-	Research	-

Project	-	Continual assessment of knowledge	-	Written seminar paper	-	Practical work	-
Online activity	-						
<p>1.9. Grading and assessment of student work during the semester and for the final exam (<i>interim exam, written exam, oral exam</i>)</p> <p>Every student activity is scored with a certain number of points:</p> <ul style="list-style-type: none"> - Attendance at lectures and exercises: minimum of 5 points, maximum of 10 points - Continual assessment of knowledge: minimum of 50 points, maximum of 80 points - Final exam: minim of 5 points, maximum of 100 points <p>Passing the example requires achieving a minimum of 60 points, where the maximum number of points is 100.</p>							
<p>1.10. Mandatory literature (relevant at the time of submitting the proposed study program)</p> <ul style="list-style-type: none"> - Lukačević, Z. Zavarivanje, Strojarski fakultet u Slavskom Brodu, 1998. - Kralj, S., Andrić, Š.: Osnove zavarivačkih i srodnih postupaka, Sveučilište u Zagrebu, 1992., ISBN 86-7819-043-4 - Samardžić i dr. Analiza tehnološkiosti zavarenih konstrukcija, digitalni udžbenik, http://www.sfsb.hr/kth/zavar/index.html 							
<p>1.11. Supplementary literature (relevant at the time of submitting the proposed study program)</p> <ul style="list-style-type: none"> - Podloge za stručni seminar: Visokoučinski postupci zavarivanja, HDTZ, 2002. - Zbornici radova s međunarodnog znanstveno-stručnog savjetovanja od SBZ 2001 do SBZ 2019. - Meden, G.; Pavletić, A.; Pavletić, D.: Osnove zavarivanja, Rijeka, Tehnički fakultet u Rijeci, 2000. - Gojić, M: Tehnike spajanja i razdvajanja materijala, Sisak, Metalurški fakultet Sisak, 2003. - Kralj, S., Andrić, Š.: Osnove zavarivačkih i srodnih postupaka, Sveučilište u Zagrebu, 1992., ISBN 86-7819-043-4 							
<p>1.12. Manner of tracking quality to ensure the acquisition of exit knowledge, skills and competences</p>							
<p>2. COMBINING THE LEARNING OUTCOMES, TEACHING METHODS AND ASSESSMENT OF THE LEARNING OUTCOMES</p>							
2.1. Class participation		2.2. Student participation		2.3. Learning outcome		2.4. Assessment method	

Attendance of lectures, (laboratory) exercises	Actively following lectures, participation in discussions, presenting one’s own opinion	1 - 6	Records of student attendance.
Continual assessment of knowledge	Solving the written part of the exam	1 – 6	Interim exam, written exams
Final exam	Solving the oral part of the exam	1 – 6	Oral assessment of knowledge