

Name	Industrial metrology		
Code	CTC-KG-06		
ECTS			
Location	CTC Kragujevac, University of Kragujevac, Faculty of Mechanical Engineering, Sestre Janjić 6, 34000 Kragujevac, Srbija		
Lecturer/s	Vladan Luković		
Objective	Considering the trends that are present in the world market, when it comes to providing quality products, metrology has become an essential part of today's world. Metrology is not activity that is performed only in specialized institutions or in calibration laboratories. To meet society's needs for accurate and reliable measurements in many applications, a strong spirit of metrology must exist in companies and enterprises. The essence of the training is to familiarize participants with the role of metrology in the production process, the ways in which to perform quality control, international standards related to the coordinate metrology, and to gain basic practical knowledge of measurement on coordinate measuring machines and CNC machine control performance,		
Recommended enrollment level	-		
Special demands	-		
Duration	40 hours		
General goals	Participants who master this training will: <ul style="list-style-type: none"> • understand the role of metrology in production and quality control methods • know what are the main features of measurement: traceability and uncertainty • know how to measure on the coordinate measuring machine • know how to perform the testing machine • know how to control the machine's performance by using control devices 		
Areas	<ol style="list-style-type: none"> 1. The role of metrology in modern manufacturing 2. Measurement of uncertainty and traceability 3. ISO Geometrical product specifications 4. Coordinate Metrology 5. Multisensor coordinate measuring machines 6. The practical use of coordinate measuring machines 7. Non contact metrology, scanning 8. Testing of machines 9. Ball-bar device for testing machine 10. Practical use of Ball-bar device 		
Specific learning outcomes by areas	Area 1: <i>The role of metrology in modern manufacturing</i>	No. of hours	2
	Participants should to be able to: <ul style="list-style-type: none"> • recognize the importance of metrology in modern society • recognize the role of metrology in the production cycle • know measurement techniques • understand the importance of metrology infrastructure 		
	Area 2: <i>Measurement of uncertainty and traceability</i>	No. of hours	2
	Participants should to be able to: <ul style="list-style-type: none"> • know the sources of errors that occur during the measurement • know how to measure uncertainty and traceability 		
	Area 3: <i>ISO Geometrical product specifications</i>	No. of hours	4
	Participants should be familiar with: <ul style="list-style-type: none"> • međunarodnih standarda GPS • dimenzionim tolerancijama i njihovom verifikacijom • geometrijskim tolerancijama i njihovom verifikacijom 		

Area 4: Coordinate Metrology	No. of hours	4
Participants should be able to: <ul style="list-style-type: none"> • recognize the importance of coordinate metrology • know all systems of sensors that exists in coordinate measuring machines • know the measurement procedures on coordinate measuring machines • know what is traceability of measurement on coordinate measuring machines • know the process of verification of coordinate measuring machines • know how to valorize the uncertainty of measurement on coordinate measuring machines 		
Area 5: Multisensor coordinate measuring machines	No. of hours	4
Participants should be able to: <ul style="list-style-type: none"> • multisensor measuring machine WERTH Video Check IP 250 and with its: <ul style="list-style-type: none"> – system of sensors – WinWerth software – Comparison of 2D i 3D datas with model in software BestFit and ToleranceFit – programming and control of coordinate measuring machine with 2D and 3D CAD data 		
Area 6: The practical use of coordinate measuring machine	No. of hours	8
Participants should be able to: <ul style="list-style-type: none"> • measure the basic feature of the coordinate measuring machine with optic • measure the basic feature of the coordinate measuring machine using a laser sensor • transform the coordinate system • apply specific measuring strategies on workpiece • compare measurement results with CAD model 		
Area 7: Non contact metrology, scanning	No. of hours	4
Participants should be able to: <ul style="list-style-type: none"> • know the basics of non contact metrology • know the working principles and classification of optical techniques • identify sources of error • know how to perform standardization and methods of testing • explain the process of reverse engineering 		
Area 8: Testing of machines	No. of hours	2
Participants should be able to: <ul style="list-style-type: none"> • know which parameters affect on tolerances • know impact of the machines on tolerances 		
Area 9: Ball-bar device for testing machine	No. of hours	2
Participants should be able to: <ul style="list-style-type: none"> • understand the working principle of QC10 Ballbar device • identify errors that can be detected 		
Area 10: Practical use of Ball-bar device	No. of hours	8
Participants should be able to: <ul style="list-style-type: none"> • perform calibration of Ballbar QC10 device • measure the performance of CNC machines in all three planes • perform software simulation of error correction 		

Portfolio of assessment

Trainer evaluates level of succes in overcoming the training of each student, through assessments exercises and testing.

Rating exercise: Exercise trainer defined on the basis of which can be implemented to assess the degree of learning outcomes. The exercises can be performed individually or in team, in groups of 2-5 trainees.

Examination: Test is defined by trainer on basis of examination which can assess the cognitive skills and their application. For this purpose it is necessary to respond to a range of questions. Answers to questions are provided in writing and orally, in a conversation with trainer evaluator.

Evaluation:

Meet	50 - 64%
Successful	65 - 79%
Excellent	80 - 100%

Performance criteria and the percentage of representation of these techniques in the evaluation module will be given later.