SYLLABUS [1]

THIS COURSE UNIT IS TAUGHT IN ROMANIAN LANGUAGE

1. Information about the program

1.1 Higher education institution	Politehnica University Timisoara
1.2 Faculty[2] / Department[3]	Mechanical Engineering / Materials and Manufacturing Engineering
1.3 Chair	—
1.4 Field of study (name/code[4])	Industrial Engineering / 20.70.10
1.5 Study cycle	Master
1.6 Study program (name/code/qualification)	Polymer and composite products engineering / Integrated Engineering

2. Information about discipline

2.1 Name of discipline/The educational classe[5]			Three-Dimensional Measurements				
2.2 Coordinator (holder) of course activities			Assoc. Prof. Phd. eng. Aurel TULCAN				
2.3 Coordinator (holder) of applied activities[6]			Assoc. Prof. Phd. eng. Aurel TULCAN				
2.4 Year of study[7]	2	**2.5** Semester	3	**2.6** Type of evaluation	E	**2.7** Type of discipline[8]	DA

3. Total estimated time (direct activities (fully assisted), partially assisted activities and unassisted activities[9])

3.1 Number of hours fully assisted/week	3 ,of which:	**3.2** course	1,5	**3.3** seminar/laboratory/project		1,5
3.1* Total number of hours fully assisted/sem.	42 ,of which:	**3.2*** course	21	**3.3*** seminar/laboratory/project		21
3.4 Number of hours partially assisted/week	3 ,of which:	**3.5** project, research		**3.6** training	**3.7** hours designing M.A. dizertation	
3.4* Number of hours pasrtially assisted/ semester	42 ,of which:	**3.5*** project of research		**3.6*** training	**3.7*** hours designing M.A. dizertation	
3.8 Number of hours of unassisted activities/ week	2,8 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field				0,3
		Study using a manual, course materials, bibliography and lecture notes				1,5
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays				1
3.8* Total number of hours of unasssited asctivities/ semester	39 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field				4
		Study using a manual, course materials, bibliography and lecture notes				21
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays				14
3.9 Total hrs./week[10]	8,8					
3.9* Total hrs./semester	123					
3.10 No. of credits	7					

4. Prerequisites (where applicable)

4.1 Curriculum	• Preferably, a graduate of a bachelor's degree program in the field of studies:

[1] The form corresponds to the Syllabus promoted by OMECTS 5703/18.12.2011 (Annex 3), updated based on the Specific Standards ARACIS of December 2016.
[2] The name of the faculty which manages the educational curriculum to which the discipline belongs
[3] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[4] Fill in the code provided in HG no. 376/18.05.2016 or in HG similars annually updated.
[5] The educational classes of disciplines (ARACIS – specific standards, art./paragraph 4.1.2.a) are: fundamental disciplines, field disciplines, majoring/specialization disciplines.
[6] The applied activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[7] The year of study to which the discipline is provided in the curriculum .
[8] The types of disciplines (ARACIS – specific standards, art./paragraph 4.1.2.a) are: extended knowledge discipline / advanced knowledge discipline and synthetic discipline (DA / DCAV and DS) or art./paragraph 4.1.2 b) complementary discipline (DC)).
[9] Within UPT, the number of hours from 3.1*, 3.2*,…,3.9* are obtained by multipling by 14 (weeks) the number of hours from 3.1, 3.2,…, 3.9.
[10] The total number of hours/week is obtained by summing up the number of hours from 3.1, 3.4 şi 3.8.

	Industrial Engineering, Mechanical Engineering or Engineering and Management
4.2 Competencies	• Engineering skills developed through specific Mechanical Engineering disciplines regarding: drawings analysis, dimensional and geometric tolerances, the ability to work with CAD models

5. Conditions (where applicable)

5.1 of the course	• Room 126, SPM, video projector, whiteboard and screen
5.2 to conduct practical activities	• Laboratory of 3D Measuring

6. Specific competencies acquired through this discipline

Specific competencies	• C1.2 Use of knowledge from fundamental engineering disciplines to explain and interpret theoretical results, new phenomena, processes or situations, in broader contexts and with multiple hypotheses • C1.3 Innovative, integrated application of concepts from the areas of fundamental sciences, for solving problems incompletely determined from the design and operation of technical systems, specific to the field of Industrial Engineering • C5.1 Knowledge and description of concepts, principles and tools for quality assurance in manufacturing processes of plastic and composite products • C5.3 Knowledge and use of tools and techniques for monitoring and inspecting the quality of injected products to solve theoretical and practical problems specific to the manufacturing process • C6.1 Knowledge and competent use of investigation methods, techniques and research methods in the field of Industrial Engineering • C6.4 Use nuanced and relevant knowledge to explain, interpret, and present the results of experimental research to formulate hypotheses and constructive conclusions
Professional competencies ascribed to the specific competencies	• C1. Solving complex tasks, specific to Industrial Engineering using advanced knowledge in engineering sciences • C5. Conception, implementation and coordination of the quality management system for manufacturing processes of plastic and composite products • C6. Development and management of professional and / or research projects using acquired engineering knowledge and skills
Transversal competencies ascribed to the specific competencies	• CT1 The application of the values and ethics of the engineering profession and the responsible execution of complex professional tasks in conditions of professional autonomy and independence; promoting logical, convergent and divergent reasoning, practical applicability, evaluation and self-evaluation in decision making • CT2 Carrying out activities with the exercise of specific roles of teamwork on different hierarchical levels and with assuming leadership roles; promoting the spirit of initiative, dialogue, cooperation, positive attitude and respect for others, diversity and multiculturalism and the continuous improvement of activity

7. Objectives of the discipline (based on the grid of specific competemcies acquired)

7.1 The general objective of the discipline	• Develop of skills for the innovative solution of three-dimensional measurement problems of products. • Learning the concept of three-dimensional measurement; knowledge of Coordinate measuring machines (CMM): architecture, operation, how to choose a right CMM; mastering the measurement procedures on the coordinate measuring machines; formation of skills related to the operation on Coordinate measuring machines: calibration of probing system, part alignment, measurement of geometric elements, digitization of surfaces.
7.2 Specific objectives	• Mastering three-dimensional measurement procedures, forming decision-making skills, their use depending on the particularities of the product to be measured • Development of the argumentation capacity of the proposed measurement procedures • Teamwork, encouraging the expression of opinion and taking responsibility

8. Content

8.1 Course	Number of hours	Teaching methods
Coordinate Metrology • Accurate, efficient and comparable measurements, influences on the measurement process and measuring results, errors, 3D	4,5	Lecture, Presentation,

measurement systems • Coordinate measuring machines (CMM): history, architectures, use of CMM, CMM's main systems		Whireboard demonstration, Questioning, Illustration, Case Study, Deductive logic, Interactive debate, Use of dedicated software
Coordinate Measuring Machine with tactile sensor • TESA MicroMS 343 machine description • DEA Global Advantage 7.10.7 machine description • Probing system configuration	3	
Probing system calibration • Calibrating requirement • Calibrating a spherical probes • Generation of the probing points pattern for automatic calibration • Calibration results	1,5	
Measured plane and spatial features • Measured features: point, plane, line, circle, cylinder, cone, sphere • Probe radius compensation • Definition of the probing strategy: number of contact points required; distribution of points on different features Measured Features - Output, Min Points, Form and work planes	3	
Part coordinate systems. Alignments • Cartesian, cylindrical and spherical coordinate systems • Why do we need an alignment? • What is an alignment • Geometric product specification: geometric tolerances, datums • Part alignment: spatial alignment, planar alignment and origin • Part alignment: case studies	4,5	
CMM Measurement strategies • DCC Part Programme Creation • Measurement of metal and plastic parts • Measurement of parts with complex shapes • Measuring report	4,5	

Bibliography[11]

1. Aurel Tulcan – Măsurări tridimensionale (3D Measurements), E-book, Virtual Campus-UPT
2. Aurel Tulcan, Liliana Tulcan, Tudor Iclănzan – Sisteme de control, Editura Politehnica, Timișoara, 2006
3. Robert Roithmeier – Measuring Strategies in Tactile Coordinate Metrology, 3rd Complete Revised Edition, Oberkochen, Germany, 2014
4. Robert J. Hocken, Paulo H. Pereira, Coordinate Measuring Machines and Systems, Second Edition, CRP Press, Taylor&Francis Group, 2012
5. Hexagon Manufacturing Intelligence, PC-DMIS CMM Manual For Version 2019 R2
6. ***, Mouvement Française pour la qualité, Machines à mesurer tridimensionelle, Paris, 1998
7. David Flack. CMM Measurement Strategies, Measurement Good Practice Guide No. 41, National Physical Laboratory, UK, 2001
8. Henrik S. Nielsen, The ISO Geometrical Product Specification Handbook, Ed. ISO Danish Standards, 2012
9. Drake P. J., Dimensioning and Tolerancing Handbook, Mc-Grow-Hill, New York, 1999, format electronic (CD)
10. ISO 1101: 2016 - Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out
11. ISO 5459: 2018 – Geometrical product specifications (GPS) _ Geometrical tolerancing – Datums and datum systems.

[11] At least one title must belong to the department staff teaching the discipline, and at least one title must refer to a relevant work for the discipline, a national and international work that can be found in the UPT Library.

8.2 Applied activities[12]	Number of hours	Teaching methods
TESA MicroMs 343 and DEA Global Advantage 7.10.7 Coordinate Measuring Machine	1,5	Problem exposure, Whiteboard demonstration, Questioning, Case Study, Deductive logic, Interactive debate, Teamwork, Practical work, Conversation, Use of dedicated software
Probe Definition and Calibration	1,5	
Measured Features	3	
Parts Alignment. Case studies	3	
Define the part datum to be used within the coordinate system according ISO 1101 and ISO 5459	3	
Basic Dimensioning, Constructed Features	3	
DCC Part Programme Creation for various industrial parts. Case studies.	6	

Bibliography[13]

1. Aurel Tulcan – Măsurări tridimensionale (3D Measurements), E-book, Virtual Campus-UPT
2. Aurel Tulcan, Liliana Tulcan, Tudor Iclănzan – Sisteme de control, Editura Politehnica, Timișoara, 2006
3. Robert Roithmeier – Measuring Strategies in Tactile Coordinate Metrology, 3rd Complete Revised Edition, Oberkochen, Germany, 2014
4. Robert J. Hocken, Paulo H. Pereira, Coordinate Measuring Machines and Systems, Second Edition, CRP Press, Taylor&Francis Group, 2012
5. Hexagon Manufacturing Intelligence, PC-DMIS CMM Manual For Version 2019 R2
6. ***, Mouvement Française pour la qualité, Machines à mesurer tridimensionelle, Paris, 1998
7. David Flack. CMM Measurement Strategies, Measurement Good Practice Guide No. 41, National Physical Laboratory, UK, 2001
8. Henrik S. Nielsen, The ISO Geometrical Product Specification Handbook, Ed. ISO Danish Standards, 2012
9. Drake P. J., Dimensioning and Tolerancing Handbook, Mc-Grow-Hill, New York, 1999, format electronic (CD)
10. ISO 1101: 2016 - Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out
11. ISO 5459: 2018 – Geometrical product specifications (GPS) _ Geometrical tolerancing – Datums and datum systems.

9. Coroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program

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10. Evaluation

Type of activity	**10.1** Evaluation criteria[14]	**10.2** Evaluation methods	**10.3** Share of the final grade
10.4 Course	Grade 5 is given for 50% knowledge of each subject, and grade 10 for 100% knowledge of each subject	Summative evaluation through a written paper, which consists of a theoretical topic, a synthesis topic and an applied topic	60%
10.5 Applied activities	**S:**		
	L: Grade 5 is given for the answer to 50% of the questions and grade 10 for the answer to all the questions	Topic questions asked during the laboratory sessions. Assessment of practical skills.	40%
	P:		
	Pr:		

[12] The types of applied activities are those mentioned in 5. If the discipline containes more types of applied activities then they are marked, consecutively, in the table below. The type of activity will be marked distinctively under the form: „Seminar:", „Laboratory:", „Project:" and/or „Practice/Training:".

[13] At least one title must belong to the staff teaching the discipline.

[14] The Syllabus must contain the evaluation method of the discipline, specifying the criteria, the metods and the forms of evaluation, as well as mentioning the share attached to these within the final mark. The evaluation criteria must correspond to all activities stipulated in the curriculum (course, seminar, laboratory, project), as well as to the methods of continuous assessment (homework, essays etc.)

	Tc-R[15]:		
10.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified[16]			
• The minimum amount of knowledge to pass the discipline is 50% of the total volume of knowledge taught. • The student has to use the correct expression of defined notions and concepts and to solve and explain topics of medium complexity.			

Date of completion	**Course coordinator (signature)**	**Coordinator of applied activities (signature)**
Head of Department (signature)	**Date of approval in the Faculty Council [17]**	**Dean (signature)**

[15] Tc-R= Homework-Reports
[16] For this point turn to "Ghid de completare a Fișei disciplinei" found at: http://univagora.ro/m/filer_public/2012/10/21/ghid_de_completare_fisa_disciplinei.pdf
[17] The approval is preceeded by discussing the study program's board's point of view with redgards to the syllabus.