SYLLABUS

Course description

Course code	Course	**PROGRAMOWANIE OBRABIAREK CNC**	
MB/O/I/NST/C2A.13		**PROGRAMMING OF CNC MACHINE TOOLS**	
Language of instruction	English		
Academic year	2023/2024		
field of study:	Mechanical engineering		
field of specialisation:	Designing and Manufacturing of Machines		
Educational level	first-cycle studies		
Education profile	General academic		
Mode of study	Part-time studies		
Semester(s)	6		
Affiliation with a group of classes	Specialization module		
Course status	obligatory		
Types of classes, instruction hours, ECTS credits	Types of classes	Number of instruction hours	Number of ECTS credits
	Lecture	16 [h]	4 ECTS
	Classes	16 [h]	
Linkage of the course	with the education profile	related to the conducted scientific activity in the discipline to which the field of study is assigned (general academic profile)	4 ECTS
	with qualifications	it is used to acquire engineering competences by the student	4 ECTS
	with science discipline	Mechanical engineering	4 ECTS
Form of teaching	Traditional – classes organized at the University /classes conducted using online learning methods and techniques		
Prerequisites	Knowledge and skills in the field of engineering graphics, CNC machine tools.		
Department	Faculty of Mechanical Engineering		
Coordinator	Zbigniew Siemiątkowski, PhD Eng., Prof. UTH Rad		
The website of the basic organizational unit	www.wm.uniwersytetradom.pl		
E-mail address, phone number of the coordinator	z.siemiatkowski@uthrad.pl, tel. 48 361 76 17		

LEARNING OUTCOMES, CURRICULUM CONTENT, TEACHING CLASSES, VERIFICATION OF LEARNING OUTCOMES

Learning Objective:	C1 - the aim of the course is to acquire the ability to record information construction and technology in alphanumeric G-code (DIN/ISO) for numerical control systems of machine tools CNC
Curriculum Content:	The content of the classes is related to the conducted scientific research. Lecture: Historical information on the development of programming languages for control systems of numerically controlled machine tools. Geometric basics: workpiece positions; Cartesian coordinates; polar coordinates; absolute dimension; incremental dimension; working planes; zero points and reference points; coordinate systems - machine coordinate systems (MCS) and workpiece coordinate system (WCS); how are the different coordinate systems related to each other? Fundamentals of NC programming: NC program name; program header; structure and content of the NC program; blocks and block components; available characters. Tool change: tool call with command (T); tool change with M06. Tool offsets: Call of tool offset (D). Spindle movement: spindle speed (S), direction of spindle rotation (M3, M4, M5); constant cutting speed (G96); constant speed G97; programmed spindle speed limit. Feed adjustment (F) (G94, G95). Geometry settings: settable work offset (G54 to G57); selection of the working plane (G17, G18, G19); dimension data - specifying an absolute dimension (G90, AC), specifying an incremental dimension (G91, IC); inch or metric dimensions (G70, G71). Path Commands: Motion Commands with Cartesian Coordinates - Rapid Traverse Motion (G0), Linear Interpolation (G1), Circular Interpolation (G2/G3); polar coordinate move commands - polar coordinate reference point (G110, G111, G112), polar coordinate move commands (G0, G1, G2, G3, AP, RP); chamfer, rounding (CHF, CHR, RND). Tool radius compensation (G40, G41, G42). Path behavior: Exact stop (G60); continuous-path (G64). Coordinate transformations - concept, instructions. Auxiliary functions (M). Supplementary commands. Programming with the use of machining cycles - machining of holes, pockets, contours. Discussion of examples of turning and milling programming. Project classes: Thematic classes based on the MTS program and/or on the basis of the Siemens Sinutrain program. Basic functions of the coordinate system and technological functions and their application. Programming of simple contours (G0/G1, G2/G3, RND, CHF/CHR) in turning. Programming of simple contours (G0/G1, G2/G3, RND, CHF/CHR) in milling. Contour programming with tool radius compensation (G41/G42). Graphical contour programming (contour calculator). Advanced programming using turning machining cycles. Advanced programming with the use of milling machining cycles. Programming of comprehensive machining of parts on a CNC turning center. Programming of comprehensive machining of parts on a CNC milling center.
Didactic (educational) methods:	− a method giving an informative lecture − method of exposing the show, − software method using a computer, − practical method design exercises with the use of audiovisual means
Course assessment type, the criteria for assessing the achieved learning outcomes, and the method of calculating the final grade:	The condition for passing a subject is to achieve the required learning outcomes specified for a given subject. Form of passing the lecture - written exam. Completion of laboratory classes on the basis of a control project. Obtaining positive grades in all forms of classes included in a given subject is tantamount to passing it and obtaining by the student the number of ECTS points assigned to this subject.

Learning outcomes for the course in relation to the field of study learning outcomes and the type of classes				Methods of verifying learning outcomes	
Learning outcome number	Description of the learning outcomes for the course (PEU) A student who has passed the course (**W**) knows and understands / (**U**) can / (**K**) is ready to:	Field of study learning outcome (KEU)	Types of classes	Form of verification (credits)	Methods of testing and assessment
W1	Has basic knowledge of development trends in the design, manufacture, construction and operation of machines.	K_WG14	L	Exam	Control Test
W2	He has elementary knowledge in the field of numerical methods and computer programs used to program the control systems of CNC machine tools and in the processes of designing and manufacturing machines.	K_WG17	L	Exam	Control Test
U1	He can use computer methods to solve engineering tasks in the field of design, manufacture and operation of machines and devices.	K_UW05	P	Graded credit	Control project
U2	Can, in accordance with the given specification, design and implement a technological process, typical for the process of designing, manufacturing and operating machinery and equipment, using appropriate methods, techniques and tools.	K_UW10	P	Graded credit	Control project
K1	Is aware of the responsibility related to decisions made as part of engineering activities, especially in terms of own and other people's safety and environmental protection	K_KO04	L, P	Verbal	Conversation

Literature and teaching aids
1. Fundamentals of CNC Machining. A Practical Guide for Beginners. Autodesk, Inc. 2014 2. Ken Evans: Programming of CNC Machines. Industrial press, Inc. 4th edition. 2016 3. Fundamentals of CNC Programming with SinuTrain. Training document. Siemens AG, 2010 4. Sinumerik Operate SinuTrain Turning made easy with ShopTurn / Mill. Training document, Siemens AG, 2013 5. Sinumerik 840D sl/828D. Fundamentals. Programming Manual. Siemens AG, 2018 6. Sinumerik 840D sl/828D with SINUMERIK Operate – Turniung / Milling. Siemens AG, 2020

Student workload required to achieve the assumed learning outcomes – the balance of ECTS credits			
Attendance, participation	Student workload [h].		
	Other contact hours (IGK)	Student's self-study hours Classes without a teacher (ZBN)	Classes
Participation in ... lectures	X	X	16 [h]
Participation in .... classes/laboratory classes	X	X	16 [h]
Meeting with teachers during their duty hours	4 [h]	X	X
Preparation for lectures/classes/.... , Preparation for ... credit / exam	X	40 [h] 24 [h]	X
Total student workload	4 [h] / 0.2 ECTS	64 [h] / 2.5 ECTS	32 [h] / 1.3 ECTS
ECTS credits for the course	100 [h] / 4 ECTS		

Additional information, comments
In the case of students with special needs, including disabilities, and chronic illnesses, the methods and forms of verification of learning outcomes specified above (in the syllabus) are adapted to the individual needs of these students, as appropriate. Detailed rules and forms of support for students with special needs, including those with disabilities and chronically ill, during classes, credits, and exams are specified in: University Regulations (Regulamin Studiów Uniwersytetu Technologiczno-Humanistycznego w Radomiu), Study Regulations (Zasady Studiowania), and Procedure for Ensuring Accessibility of the Educational Process to Students with Special Needs, Including Those with Disabilities and Chronically ill (Procedura dotycząca zapewnienia dostępności procesu kształcenia studentom ze szczególnymi potrzebami, w tym: z niepełnosprawnością, przewlekle chorych).