



# POLYTECHNIC OF MEĐIMURJE IN ČAKOVEC

## COURSE SYLLABUS

ACADEMIC YEAR: 2020/2021

### 1. GENERAL COURSE INFORMATION

<b>1.1 Course name</b>	Digital signal processing			
<b>1.2 Study program/s</b>	Undergraduate professional study of Computer Science			
<b>1.3 Course status (M,E)</b>	Electoral	<b>1.6 Mode of instruction (number of hours)</b>	<b>Lectures</b>	30
<b>1.4 Course code</b>			<b>Exercises</b>	30
<b>1.5 Course abbreviation</b>	DOS		<b>Seminars</b>	
<b>1.6 Semester</b>	IV		<b>E-learning</b>	
<b>1.7 ECTS</b>	4	<b>1.7 Place and time of instruction</b>	Premises of the Polytechnic of Međimurje in Čakovec, according to the schedule published on the website	

### 2. TEACHING STAFF

<b>2.1 Course leader/s-title</b>	Željko Knok/ Master of Science	<b>contact</b>	zknok@mev.hr
		<b>contact</b>	
<b>2.2 Assistant/s- title</b>		<b>contact</b>	
		<b>contact</b>	
<b>2.3 Instruction held by- title</b>		<b>contact</b>	

### 3. COURSE DESCRIPTION

<b>3.1 Course goals</b>	After completing the course, the student will master the basic theoretical settings and characteristic examples of signal application, and the most common procedures for their processing in computer-communication systems.									
<b>3.2 Prerequisites</b>	The student does not need entry competencies to enroll and take the course									
<b>3.3 Course outcomes</b>	After successfully completing the course, students will be able to: O1 - Evaluate the role of signals in computer-communication systems O2 - Use computer signal generation and display O3 - Use algorithms for signal processing and analysis O4 - Use nonlinear signal processing									
<b>3.4 Course content</b>	The course presents contents related to working with the database through objects, stored tasks, permissions and access controls. In the practical part, open source tools are used.									
<b>3.5 Types of coursework</b>	x	Lectures	x	Exercises		Blended e-learning	x	Individual activities		Laboratory
		Seminars and workshops		Distant learning		Field classes	x	Multimedia and network		Mentorship
		Other								
<b>3.6 Language of instruction</b>	Croatian /English									
<b>3.7 Monitoring students' work (enter the number of ECTS credits for each activity so that the</b>	1,00	Class attendance				Seminars			Essay	
	1,00	Class activity				Project			Report/paper	
	1,00	Midterm exams			1,00	Practical task			Continuous knowledge check	
		Written exam				Experimental work				

<p><b>total number of ECTS credits is equal to the total ECTS value of the course, 1 ECTS = 30 hours)</b></p>	<p>Oral exam</p>	<p>Research</p>																																																																					
<p><b>3.8 Assessment and evaluation of students' work during classes and at the final exam</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;">Activity specification</th> <th style="width: 20%;">Percent %</th> <th style="width: 20%;">Points</th> </tr> </thead> <tbody> <tr> <td colspan="3" style="text-align: center;">Assessment during instruction</td> </tr> <tr> <td>Attendance</td> <td style="text-align: center;">5%</td> <td style="text-align: center;">5</td> </tr> <tr> <td>Class activity</td> <td style="text-align: center;">5%</td> <td style="text-align: center;">5</td> </tr> <tr> <td>Seminar/ project/ essay</td> <td style="text-align: center;">30%</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Midterm exam 1</td> <td style="text-align: center;">30%</td> <td style="text-align: center;">30</td> </tr> <tr> <td>Midterm exam 2</td> <td style="text-align: center;">30%</td> <td style="text-align: center;">30</td> </tr> <tr> <td colspan="3" style="text-align: center;"><i>Exam assessment for the students who failed to fulfil all the obligatory requirements during the semester</i></td> </tr> <tr> <td>Written exam</td> <td style="text-align: center;">60%</td> <td style="text-align: center;">60</td> </tr> <tr> <td><b>Total:</b></td> <td style="text-align: center;"><b>100%</b></td> <td style="text-align: center;"><b>100</b></td> </tr> </tbody> </table>			Activity specification	Percent %	Points	Assessment during instruction			Attendance	5%	5	Class activity	5%	5	Seminar/ project/ essay	30%	30	Midterm exam 1	30%	30	Midterm exam 2	30%	30	<i>Exam assessment for the students who failed to fulfil all the obligatory requirements during the semester</i>			Written exam	60%	60	<b>Total:</b>	<b>100%</b>	<b>100</b>																																						
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<p><b>3.10 Specific features related with taking the course</b></p>	<p>If a student collects 50% of the points of each outcome, he / she directly takes the exam, provided that he / she has done practical work (exercises). A student cannot access the exam period if he / she has not achieved min. 60% correct answers. Practical work-exercises are made according to the instructions published on the Merlin system and are submitted by posting on the Merlin. Checking the completed exercises is done in the exercise classes after prior preparation with the teacher. During the semester, the student is required to perform five exercises independently. Practical work (completed exercises) is taught until the last week of lectures. During the exam, it is possible to orally check the knowledge from practical work (exercises).</p> <p>If a student does not achieve a sufficient number of points on the midterm exam, he / she cannot take the next midterm exam.</p> <p>Once achieved points in intermediate exams for each learning outcome are no longer deleted unless the student decides to correct the result for each learning outcome, whereby the points won until then are deleted and newly achieved points for that learning outcome are entered.</p> <p>The final grade is obtained on the exam period and is the sum of points earned during classes.</p>																																																																						

	Students who did not take the colloquium access the written part of the exam where all learning outcomes are checked, and are required to have completed exercises before taking the exam.	
<b>3.11 Students obligations</b>	<p>Full-time students are required to attend at least 70% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. Part-time students are required to attend at least 30% of the total number of hours of lectures and exercises in order to exercise the right to take the exam. If the student has not fulfilled all the obligations set by the course, he is obliged to attend the lectures again and meet the conditions for taking the exam.</p> <p>Attendance can be offset by online tuition, organised webinars and added assignments given by teachers. One lesson lasts 45 minutes, and several hours form a teaching unit. Absence from one teaching unit is counted as one absence. Delays and apologies are recorded separately. In that case, if the student missed more than 50% of classes, and has a justifiable reason/apology, the request should be submitted to the Department Council, which then decides on the justification of student absences with the obligatory opinion of the course leader.</p>	
<b>3.12 Written assignments</b>		
<b>3.13 Required reading</b>	1.	Digital Signal Processing, 4rd Edition, Dimitris K Manolakis, John G. Proakis, (April 7, 2006)
	2.	
<b>3.14 Additional reading</b>	1.	Fluent Python. CLEAR, CONCISE, AND EFFECTIVE PROGRAMMING, Luciano Ramalho, Published August 20th 2015 by O'Reilly Media
	2.	THINK DSP. DIGITAL SIGNAL PROCESSING IN PYTHON. Allen B. Downey, O'Reilly Media
<b>4 ADDITIONAL COURSE INFORMATION</b>		
<b>4.1 Quality control</b>	The quality of the program, teaching process, teaching skills and level of mastery of the material will be established by conducting a written evaluation based on questionnaires, and in other standardised ways and in accordance with the by-laws of the Polytechnic of Međimurje in Čakovec.	
<b>4.2 Contact the teacher</b>	Students can contact the teacher during the office hours and during classes, while for short questions and explanations they can contact him/her any day during working hours by coming in person or by landline. It is also possible to ask questions by e-mail, which will be answered in 48 hours at the latest. It is desirable for students to come as often as possible for any possible questions during the teacher's office hours.	
<b>4.3 Information about the course</b>	It is the obligation of each student to be regularly informed about the course. All notifications about the classes or possible postponement of classes will be posted on the bulletin board and on the website of the Polytechnic at least 24 hours in advance.	

<b>4.4 Course contribution to the study program</b>	Apply the acquired learning skills, basic knowledge of the profession and problem solving necessary for continuing studies at a higher level. Analyze the basic elements of electrical engineering and digital circuits and identify the structure of the computer.
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**5. ANALYSIS OF COURSE TOPICS (the number of hours is equal to the number of lectures and exercises of the course)**

<b>LECTURES</b>				
<b>Week</b>	<b>Topic and description</b>	<b>Method</b>	<b>Learning outcomes</b>	<b>Course outcome</b>
		<ul style="list-style-type: none"> <li>• Direct teaching (lecture, instruction, pp presentation)</li> <li>• Discovery learning (individual, lead, discussion)</li> <li>• Group learning</li> <li>• Case study</li> <li>• Field classes...</li> </ul>		
1.	Introduction to course content, signal types and their role in cybernetic systems	Direct teaching (lecture, instruction, pp presentation)	Distinguish signals and their roles	O1
2.	Elementary continuous signals	Direct teaching (lecture, instruction, pp presentation)	Distinguish elementary signals	O1
3.	Transformation of continuous signals over time	Direct teaching (lecture, instruction, pp presentation)	Apply various signal modifications over time t	O2
4.	Fourier analysis of continuous signals	Direct teaching (lecture, instruction, pp presentation)	Apply DFT and IFT on examples	O2
5.	Elementary digital signals	Direct teaching (lecture, instruction, pp presentation)	Distinguish types of digital signals	O1
6.	Transformation of digital signals	Direct teaching (lecture, instruction, pp presentation)	Apply various signal modifications through the variable n	O2
7.	Laplace transformation	Direct teaching (lecture, instruction, pp presentation)	Use different flow control tools	O3
8.	Mid-term exam 1			O1-O2
9.	Z Transformation	Direct teaching (lecture, instruction, pp presentation)	Explain the concept of Z transformation	O3
10.	Inverse Z transformation	Direct teaching (lecture, instruction, pp presentation)	Explain the concept of inverse Z transformation	O3
11.	Signal filtering - filters	Direct teaching (lecture, instruction, pp presentation)	Explain the role and concept of signal filtering	O4

12.	Butervortov filter	Direct teaching (lecture, instruction, pp presentation)	Apply the Butterworth filter	O4
13.	Audio signal processing	Direct teaching (lecture, instruction, pp presentation)	Describe the audio signal through parameters	O4
14.	Audio signal spectrogram	Direct teaching (lecture, instruction, pp presentation)	Display an audio signal spectrogram	O4
15.	Mid-term exam 2			O3-O4
<b>EXERCISES/ SEMINARS</b>				
<b>Week</b>	<b>Topic and description</b>	<b>Method</b> <ul style="list-style-type: none"> <li>• Direct teaching (lecture, instruction, pp presentation)</li> <li>• Discovery learning (individual, lead, discussion)</li> <li>• Group learning</li> <li>• Case study</li> <li>• Field classes...</li> </ul>	<b>Learning outcomes</b>	<b>Course outcome</b>
1.	Introduction to signal processing using Python	Direct teaching (lecture, instruction, pp presentation)	Explain the program installation procedure	O1
2.	Drawing and processing of continuous and digital signals, periodic and aperiodic signals, even and odd	Guided task, code examples	Apply drawing functions	O1
3.	Drawing elementary continuous and digital signals	Guided task, code examples	Apply drawing functions	O1
4.	Drawing signals $x[n]$ and $x[5n]$ , even and odd	Guided task, code examples	Apply drawing functions	O2
5.	Drawing a nonlinear signal, inverting with offset	Guided task, code examples	Apply drawing functions	O2
6.	Exercise 1 - Generating and displaying signals	Independent preparation of the exercise	Apply functions to generate and display signals	O2
7.	Calculate the convolution of two signals of different durations	Guided task, code examples	Apply modules and convolution calculation function	O2
8.	Exercise 2 - A / D and D / A conversion	Independent preparation of the exercise	Apply signal conversion functions	O2
9.	Drawing DFT and IDFT	Guided task, code examples	Apply signal transformation functions	O3
10.	Exercise 3 - DFT and IDFT, Z-trans.	Independent preparation of the exercise	Apply signal transformation functions	O3
11.	Signal samples, process	Guided task, code examples	Show on a simple example the procedure	O3

<b>12.</b>	Exercise 4 - Discrete, time-invariant, linear systems	Independent preparation of the exercise	Apply signal transformation functions	O3
<b>13.</b>	Butervortov filter	Guided task, code examples	Use this signal processing filter	O4
<b>14.</b>	Exercise 5 - Audio signal processing	Independent preparation of the exercise	Show load, enter parameters and print audio file	O4
<b>15.</b>	Audio signal check (mono or stereo)	Direct teaching (lecture, instruction, pp presentation)	Apply signal verification functions	O4