Faculty of Electrical Engineering / APPLIED COMPUTER ENGINEERING / MULTIMEDIA SYSTEMS

Course:	MULTIMEDIA SYSTEMS			
Course ID	**Course status**	**Semester**	**ECTS credits**	**Lessons** (Lessons+Exercises+Laboratory)
1417	Mandatory	3	5	3+0+2
Programs	APPLIED COMPUTER ENGINEERING			
Prerequisites	The student should pass the exam in the subject "Mathematics in Computing".			
Aims	Students are introduced to mathematical transformations in signal processing, as well as the basics of coding and compression in multimedia systems. Methods of protection of digital audio data, digital images and videos are processed and analyzed. The transfer of data through computer networks is also processed.			
Learning outcomes	After the student passes this exam, he will be able to: - Explain some of the basic mathematical transformations used in Multimedia systems – Fourier transform and discrete cosine transform; - Use Fourier transform for signal analysis; - Explain basic algorithms for audio signal compression; - Implement the basic types of transformations over a digital image: arithmetic and geometric transformations, as well as the basic types of filters in the spatial domain – high-pass, low-pass filter and band-pass filter; - Explain the working principle of JPEG image compression; - Explain the basic characteristics of video signals and the basic concepts and algorithms that are applied when compressing video data; - Define terms and applications of digital watermarking in multimedia systems.			
Lecturer / Teaching assistant	Prof. dr. Srdjan Stanković - teacher BSc Andrej Cvijetić - associate			
Methodology	Lectures, exercises, consultations, independent work.			
Plan and program of work				
Preparing week	Preparation and registration of the semester			
I week lectures	Introduction. Sampling and quantization. Fourier and Discrete cosine transform.			
I week exercises	Introduction. Sampling and quantization. Fourier and Discrete cosine transform.			
II week lectures	Digital audio and speech signals. Psychoacoustic effects.			
II week exercises	Digital audio and speech signals. Psychoacoustic effects.			
III week lectures	Digital audio signal compression (lossless compression – LZW, LZ-77, Huffman coding).			
III week exercises	Digital audio signal compression (lossless compression – LZW, LZ-77, Huffman coding).			
IV week lectures	Digital audio signal compression (MPEG-1, MPEG-2, MPEG-3 - MP3).			
IV week exercises	Digital audio signal compression (MPEG-1, MPEG-2, MPEG-3 - MP3).			
V week lectures	Storage of digital audio signals. CD, Mini disc, Super audio CD, DVD audio.			
V week exercises	Storage of digital audio signals. CD, Mini disc, Super audio CD, DVD audio.			
VI week lectures	Transmission of digital audio signals. Digital audio broadcasting.			
VI week exercises	Transmission of digital audio signals. Digital audio broadcasting.			
VII week lectures	Midterm test.			
VII week exercises	Midterm test.			
VIII week lectures	Digital image - basic concepts about image and basic geometric transformations on digital image.			
VIII week exercises	Digital image - basic concepts about image and basic geometric transformations on digital image.			
IX week lectures	Color models: RGB, CMY, CMYK, YUV, YCrCb. Image filtering. Determining image edges.			
IX week exercises	Color models: RGB, CMY, CMYK, YUV, YCrCb. Image filtering. Determining image edges.			
X week lectures	Basics of JPEG image compression.			
X week exercises	Basics of JPEG image compression.			
XI week lectures	Digital data protection - Digital watermarking.			
XI week exercises	Digital data protection - Digital watermarking.			
XII week lectures	Digital video. Basic terms about the video signal (Formats 4CIF, CIF, QCIF, SubQCIF and video signal			

	flow).
XII week exercises	Digital video. Basic terms about the video signal (Formats 4CIF, CIF, QCIF, SubQCIF and video signal flow).
XIII week lectures	Digital video signal compression (MPEG-1, MPEG-2, MPEG-4).
XIII week exercises	Digital video signal compression (MPEG-1, MPEG-2, MPEG-4).
XIV week lectures	Protocols and standards for data transmission: H261, H263, H264, H323, H324, H320.
XIV week exercises	Protocols and standards for data transmission: H261, H263, H264, H323, H324, H320.
XV week lectures	FINAL TEST
XV week exercises	FINAL TEST
Student workload	Weekly: 5 credits x 40/30 = 6 hours and 40 minutes Structure: 3 hours of lectures 1 hour of computational and laboratory exercises 2 hours and 40 minutes of independent work, including consultations During the semester: Classes and final exam: (6 hours 40 minutes) x 16 = 106 hours 40 minutes Necessary preparations before the beginning of the semester (administration, registration, certification) 2 x (6 hours and 40 minutes) = 13 hours and 20 minutes Total workload for the subject 5.0×30 = 150 hours Supplementary work for exam preparation in the make-up exam period, including taking the make-up exam from 0 to 30 hours (remaining time from the first two items to the total workload for the subject 150 hours) Load structure: 106 hours and 40 minutes. (Teaching) + 13 hours and 20 minutes. (Preparation)+30 hours (Supplementary work)

Per week	**Per semester**
5 credits x 40/30=6 hours and 40 minuts 3 sat(a) theoretical classes 2 sat(a) practical classes 0 excercises **1 hour(s) i 40 minuts** of independent work, including consultations	Classes and final exam: **6 hour(s) i 40 minuts x 16 =106 hour(s) i 40 minuts** Necessary preparation before the beginning of the semester (administration, registration, certification): **6 hour(s) i 40 minuts x 2 =13 hour(s) i 20 minuts** Total workload for the subject: **5 x 30=150 hour(s)** Additional work for exam preparation in the preparing exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total load for the item) **30 hour(s) i 0 minuts** Workload structure: **106 hour(s) i 40 minuts (cources), 13 hour(s) i 20 minuts (preparation), 30 hour(s) i 0 minuts (additional work)**
Student obligations	Regular attendance at classes, appropriate behavior, attending knowledge tests (midterm test and final exam).
Consultations	After the lecture, and if necessary by agreement.
Literature	S. Stanković, I. Orović: Multimedia signals and systems, ETF Podgorica 2011 S. Stankovic, I. Orovic, E. Sejdic, "Multimedia Signals and Systems: Basic and Advance Algorithms for Signal Processing," Springer-Verlag, New York, 2015
Examination methods	Midterm test 50 points 5 in tota l0 points Final exam 50 points a total of 50 points A passing grade (AE) is obtained if at least 50 points are accumulated cumulatively.
Special remarks	
Comment	

Grade:	F	E	D	C	B	A
Number of points	less than 50 points	greater than or equal to 50 points and less than 60 points	greater than or equal to 60 points and less than 70 points	greater than or equal to 70 points and less than 80 points	greater than or equal to 80 points and less than 90 points	greater than or equal to 90 points