Specification for the book of courses

Study program	Communications and Information Technologies		
Module	Communications and Information Processing		
Type and level of studies	Master studies		
The name of the course	Intelligent audio algorithms		
Lecturer (for lectures)	Ćirić G. Dejan		
Lecturer/associate (for exercises)	Ćirić G. Dejan		
Lecturer/associate (for OFE)			
Number of ECTS	4	**Course status (obligatory/elective)**	Elective
Prerequisites			
Course objectives	To understand the principles and tools used in digital audio signal processing. To convey the knowledge of intelligent algorithms in audio field. To introduce the concepts of machine based learning applications in audio field. To master audio signal characterization by means of features. To train students to use intelligent algorithms in practice (e.g. audio signal classification).		
Course outcomes	Identification of the appropriate algorithm approaches in audio field. Selection, application and evaluation of intelligent algorithms for audio signals. Mastering the techniques of analysis, decomposition and transformation of audio signals as well as classification of audio contents, forming of spatial audio, and generating virtual environment.		
Course outline			
Theoretical teaching	Audio signals and systems. Machine based learning and artificial intelligence methods in audio field. Harmonic model (harmonic detection, fundamental frequency detection, pitch detection algorithm). Extracting descriptors (features) from audio signals (energy, spectral, time and perceptual features). Decomposition of audio signals. Clustering and classification algorithms. Speech technologies in modern communication devices. Audio signal classification (auditory classes). Auditory scene analysis (e.g., application in mobile telecommunications). Sound transformation (filtering and morphing). Spatial audio (binaural audio, wavefield synthesis, Ambisonics). Virtual auditory environment. Sound detection using microphone arrays (forming of directivity, source location evaluation). Application of smart sound sources. Advanced algorithms for audio effect applications.		
Practical teaching (exercises, OFE, study and research	Computational and practical exercises: analogue and digital audio signals; audio signal processing (normalisation, segmentation, visualisation); cancelation of noise and its effects; extraction of audio descriptors-features; analysis and classification of audio signals; speech technologies in modern communication devices; spatial audio; virtual auditory environment; sound acquisition by microphone arrays.		
Textbooks/references			
1	T. Virtanen, M. D. Plumbley, D. Ellis: Computational analysis of sound scenes and events, Springer, Cham, Switzerland, 2018.		
2	A. Lerch: An Introduction to audio content analysis, Applications in signals processing and music informatics, IEEE Press and Willey, New Jersey, 2012.		
3	I. McLoughlin: Applied speech and audio processing: with Matlab examples, Cambridge University Press, Cambridge, 2009.		
4	T. Giannakopoulos, A. Pikrakis: Introduction to audio analysis - A Matlab approach, Elsevier (Academic Press), Oxford, 2014.		
5	B. Rafaely: Fundamentals of spherical microphone array processing, Springer, Berlin, 2015.		

Number of classes of active education per week during semester/trimester/year				
Lectures	**Exercises**	**OFE**	**Study and research work**	**Other classes**
2	1	0	0	0
Teaching methods	Lectures; Computational exercises; Laboratory sessions; Studio exercises; Consultations.			

Grade (maximum number of points 100)			
Pre-exam duties	**Points**	**Final exam**	**Points**
Activity during lectures	5	**Written exam**	
Exercises	30	**Oral exam**	35
Colloquia			
Projects	30		