Program	Level	Second cycle		
	Name of the program	Theoretical Computer Science		
COURSE				
Course title	**Mathematical Methods in Digital Image Processing**			
Course code	Semester	Course status	ECTS	Contact hours (L+AE+LE)
CS 470	II	Mandatory course	7	3+0+2
Lecturer				
Course Goals	The purpose of the course is to provide students with the necessary knowledge to master contemporary digital image processing processes. Students will learn to apply digital image processing algorithms in practice through theoretical and practical work.			
Learning Outcomes	Upon completing this course, students will acquire the basic knowledge necessary for analysis and image processing, both from the theoretical point of view and the implementation aspect of modern digital image processing algorithms.			

COURSE CONTENT

- An Introduction to digital image processing. The components of image processing. The perception of the image.
- Image processing application in industrial vision, Robotics, Communications, and Biomedicine.
- The models and colour spaces. Colour models. Colour spaces. Observation, acquisition, sampling, and quantization of data.
- Data structures for image analysis. One-dimensional and two-dimensional signals. Impulse Dirac delta function. Impulse response. Linear integral transformations. Convolution. Direct and inverse Fourier transform. Hilbert's transformation. Fast Fourier Transformation. Discrete and inverse discrete Fourier transform.
- Enhancement of image. The methods are based on the threshold, edges, regions, contours, and grouping.
- Frequency domain operations. Low-frequency and High-frequency operators. Nonlinear operators. The filters for image enhancement are based on fuzzy techniques and metaheuristics. The reconstruction and restoration of the image. The restoration in the presence of forest-spatial filtration. Wiener filter.
- The image reconstruction from projections. The description of the CT method. Basic concepts for CT scanner. Radon transformation. Fourier's slice theorem. Filtered back projection.
- Wavelets and multi-resolution image processing. Wavelet transformation in one-dimensional and two-dimensional spaces. Fast Wavelet transformation. Wavelet packs.
- Image compression. Lossless Compression, Huffman Codding, LZW Method, Wavelet Encoding, Predictive Coding without Loss. The compression of an image with losses, DCT, and Fractals. Colour image compression. JPEG, JPEG2000 standards.
- The morphological operations in the image. The segmentation of the image. Edge detection. Pattern recognition. Statistical classifiers. The recognition as a graph matching.
- The use of MATLAB for processing and image analysis.

LITERATURE

[1] Miodrag V. Popović, Digitalna obrada slike, (2006), Akademska misao, Beograd.

[2] Rafael C. Gonzalez, Richard E. Woods, Digital image processing, 3rd edition, (2007), Prentice Hall.

[3] Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins: Digital image processing using Matlab, 2nd edition, (2009), Gatesmark Publishing.

[4] Ravishankar Chityala, Sridevi Pudipeddi, Image Processing and Acquisition using Python, (2014), CRC Press.

STUDENT WORKLOAD (hours in a semester)

Lectures	45	Exercises	30	Individual work	100	T o t a l	175

GRADING			**REMARKS**
Criterion	Maximum points	Minimum points	

Midterm exams	20	11	
Assignments	10	5	
Projects	30	17	
Seminar paper	20	11	
Final exam	20	11	
T o t a l	100	55	