Subject (course) name: **Image Processing and Recognition**		
Programme: **Computer Science** Specialty:		Subject code: **5S** Title graduate: **Master of Science**
Type of course: **obligatory**	Course level: **Second-cycle studies**	Year: **II** Semester: **III** Semester: **summer**
Form of classes: **Lectures, Classes, Labs, Seminar, Project**	Number of hours per week: **1L, 0, 2Lab, 0, 0**	Credit points: **3 ECTS**

GUIDE TO SUBJECT

SUBJECT OBJECTIVES

C1. General knowledge in image processing and recognition techniques and algorithms.

C2. General knowledge and ability to work with commercially available software, SDKs and libraries applying the image processing and recognition algorithms.

C3. General programming skills of selected image and recognition algorithms in high level languages.

SUBJECT REQUIREMENTS

1. General knowledge in matrix algebra, programming in high-level languages.
2. General ability to work independently and ability to work in a group.
3. General ability to independently search in literature and online resources.

LERNING OUTCOMES

EK 1 - Student lists and explains typical image processing and recognition techniques and algorithms.

EK 2 - Student can work with commercially available software, SDKs and libraries applying the image processing and recognition algorithms.

EK 3 - Student can create in high level language his own software integrating selected image and recognition algorithms.

SUBJECT CONTENT

Form of classes – lectures

Topic	Hours
W1 – The course rules and requirements. What is an image, its representation.	**1**
W2 – The overview of software. The classification and discussion of typical methods of image processing.	**1**
W3 – Quantization. RBG, CMY, CMYK and HSV color models. Conversion to grey scale.	**1**
W4 – Histogram and its applications.	**1**
W5 – Arithmetic and geometrical operations.	**1**
W6 – Conversion to white-black image. Segmentation.	**1**
W7 – Digital 1D and 2D filtering.	**1**
W8 – Morphology.	**1**
W9 – The classification and discussion of typical methods of pattern recognition.	**1**
W10 – Feature extraction.	**1**
W11 – Template matching.	**1**
W12 – Bayes classifier**.**	**1**

W13 – Trees and graphs.	**1**
W14 – Neural networks and fuzzy systems.	**1**
Final test	**1**
Total	**15**

Form of classes – laboratory

Topic	Hours
Introduction	**0,5**
L1 – Working with files and dedicated software. Basic operations on images	**1,5**
L2 – Histogram	**2**
L3 – Contrast improvement	**2**
L4 – Segmentation with Otsu method	**2**
L5 – Filtering: image smoothing	**2**
L6 – Filtering: image sharpening and edge detection	**2**
L7 – Application of morphology	**2**
L8 – K-means and k-nn classification	**2**
L9 – Simple OCR	**2**
L10 – Face recognition and tracking	**2**
L11-14 – Realization of individual projects in teams of two students	**9**
Examination of programming tasks	**1**
Total	**30**

STUDY METHODS

1. Lectures using multimedia presentations and examples of code
2. Discussion during the course and in addition during individual consultations
3. Laboratory – analysis of the operation and development of software - teamwork

EDUCATIONAL TOOLS

1. Audiovisual equipment, black(white)board, lectures in electronic version
2. Laboratory equipped with PC computers with software

METHODS OF ASSESMENT (F – Forming, P – Summary)

F1. assessment of self preparation for laboratory classes – oral answer
F2. assessment of the correctness and timeliness of presentation code created
P1. lecture – written test of the theory
P2. laboratory – assessment of ability to software analysis and software development

STUDENT WORKLOAD

Form of activity	Averaged workload (hours)		
	[h]	∑ [h]	ECTS
Participation in class activities lecture laboratory consultation	15 30 2	47	2
Preparation for tutorials (reading literature)	10	28	1
Preparation for test	10		
Familiarizing yourself with the software	8		
Total		**75**	**3**

A. BASIC READING

1.	Solomon Ch., Breckon T.: Fundamentals of digital image processing. Practical approach with examples in Matlab, Wiley-Blackwell 2011.
2.	Gonzalez R., Woods R., Eddins S.: Digital Image Processing Using MATLAB, Pearson Prentice-Hall 2004.
3.	Shih F.Y: Image Processing and Pattern Recognition. Fundamentals and Techniques, Wiley and Sons, 2010.
4.	Matlab User's Guide. Image Processing Toolbox, Mathworks.

B. FURTHER READING

1. Russ J.: The Image Processing Handbook. Sixth Edition, CRC Press 2011.
2. (Ed. by) Leondes C.T.: Image Processing and Pattern Recognition, Academic Press, 1998.

Learning objectives	In relation to the learning outcomes specified for the field of study	Subject objectives	Study methods	Methods of assessment
EK1	K_W02	C1	lectures, discussion	P1
EK2	K_W02, K_U02, K_U08	C2	lectures, laboratory, discussion	P1, P2
EK3	K_U08, K_K03, K_K06	C3	laboratory, discussion	F1, F2, P2

II. EVALUATION

Grade	Outcome
EK1	**Student lists and explains typical image processing and recognition techniques and algorithms**
2 (F)	Student can not list the typical image processing and recognition techniques and algorithms.
3 (E)	Student lists and describes the typical image processing and recognition techniques and algorithms.
4 (C)	Student lists and describes the typical image processing and recognition techniques and algorithms.
5 (A)	Student lists and describes the typical image processing and recognition techniques and algorithms.
EK2	**Student can work with commercially available software, SDKs and libraries applying the image processing and recognition algorithms**
2 (F)	Student can not list any commercially available software, SDKs and libraries applying the image processing and recognition algorithms
3 (E)	Student can work with chosen commercially available software, SDKs and libraries applying the image processing and recognition algorithms at basic level
4 (C)	Student can work with chosen commercially available software or SDKs and libraries applying the image processing and recognition algorithms at advanced level
5 (A)	Student an work with any commercially available software, SDKs and libraries applying the image processing and recognition algorithms
EK3	**Student can create in high level language his own software integrating selected image and recognition algorithms**
2 (F)	Student can not create any script or function integrating image and recognition algorithms
3 (E)	Student can create in chosen high level language some scripts or functions integrating image and recognition algorithms
4 (C)	Student can create in chosen high level language simple software integrating some typical image and recognition algorithms
5 (A)	Student can create in high level language his own advanced software integrating selected image and recognition algorithms

III. OTHER USEFUL INFORMATION

1. All information for students on the schedule are available on the notice board and on the website: www.el.pcz.pl
2. Information on the consultation shall be provided to students during the first lecture and will be placed on the website www.el.pcz.pl
3. Terms and conditions of credit courses will be provided to students during the first lecture