(*faculty stamp*)

COURSE DESCRIPTION

1. Course title: ALGORITHMS AND PARADIGMS FOR PATTERN RECOGNITION	**2. Course code: WM1**
3. Validity of course description: 2018/2019	
4. Level of studies: 2nd cycle of higher education	
5. Mode of studies: intramural studies	
6. Field of study: MATHEMATICS	(FACULTY SYMBOL) RMS
7. Profile of studies: general	
8. Programme: all	
9. Semester: III	
10. Faculty teaching the course: Faculty of Applied Mathematics	
11. Course instructor: professor Giacomo Capizzi	
12. Course classification: approved programme elective (monographic lecture)	
13. Course status: elective	
14. Language of instruction: English	
15. Pre-requisite qualifications: Numerical Methods, Stochastic models, English.	
16. Course objectives: The aim of course is to familiarize students with algorithms and methods to recognize objects and programming on supported calculation platforms.	

17. Description of learning outcomes:

A student who completes the course successfully should

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	can construct algorithms with good numerical precision for solving feature recognition problems	project	lecture, laboratory	K2A_W04 K2A_U13
2.	can construct mathematical models used in specific applications of object recognition	project	lecture, laboratory	K2A_W04 K2A_W06 K2A_U13 K2A_U14
3.	understand mathematical basis of the object recognition algorithms and computational processes	project	lecture, laboratory	K2A_W07 K2A_U13
4.	can make use of stochastic processes as a tool for modeling phenomena and analyze objects	project	lecture, laboratory	K2A_U13 K2A_W05 K2A_W06
5.	know the numerical methods used for finding approximate solutions (for example, differential equations, etc.) used for object recognition	project	lecture, laboratory	K2A_W07 K2A_U06 K2A_U13
6.	can independently search for information in the foreign literature.	project	lecture, laboratory	K2A_W13 K2A_K01 K2A_K06

18. Teaching modes and hours

Lecture / BA /MA Seminar / Class / Project / Laboratory

Lecture 30h. Laboratory 30h.

19. Syllabus description:

Lecture: Image analysis and machine learning concepts, overview of supervised learning (classification and regression, Bayes decision theory, bias-variance trade-off curse of dimensionality), image features (detecting edges, lines and other features in images, hyperspectral features), unsupervised image classification (clustering and image segmentation of color images and hyperspectral data, agglomerative algorithms, graph-theory based algorithms), manifold learning (classical manifold learning techniquesapplied to natural and hyperspectral images), contextual and texture measures (texture statistics, texture recognition and synthesis, random fields), basics of neural network (why do we need machine learning? what are neural networks? some simple models of neurons, a simple example of learning, Perceptrons: simple and multilayer,

perceptrons as models of vision, types of neural network architectures, the back propagation algorithm, introduction to the full Bayesian approach, the idea of full Bayesian learing: Probabilistic Neural Network (PNN)).

Laboratories: Practical approach to theory and examples presented at lectures.

20. Examination: no

21. Primary sources:

1. Sergios Theodoridis and Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 2008.
2. Richard O. Duda and Peter E. Hart and David G. Stork, Pattern Classification, Wiley, 2001.
3. David G. Stork and Elad Yom-Tov, Computer Manual in MATLAB to Accompany Pattern Classification, Wiley, 2004.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

22. Secondary sources:

1. Christopher Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2005.
2. Sandhya Samarasinghe, Neural Networks for Applied Sciences and Engineering: From Fundamentals to Complex Pattern Recognition, Auerbach Publications, 2007.
3. Mohamad Hassoun, Fundamentals of Artificial Neural Networks, Massachusetts Institute of Technology, 1995.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	30/10
2	Classes	/
3	Laboratory	30/20
4	Project	/30
5	BA/ MA Seminar	/
6	Other: consultations, use of e-learning webpage	/30
	Total number of hours	60/60

24. Total hours: 120

25. Number of ECTS credits: 4

26. Number of ECTS credits allocated for contact hours: 4

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects): 1

26. Comments:

Assessment

To pass, it is necessary to achieve all learning outcomes described above.

Approved:

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(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*