COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering			
DEPARTMENT	Electrical and Computer Engineering			
LEVEL OF STUDY	Undergraduate			
COURSE UNIT CODE	9.010	**SEMESTER**	9º	
COURSE TITLE	Artificial Vision			
COURSEWORK BREAKDOWN			**TEACHING WEEKLY HOURS**	**ECTS Credits**
	Theory (Lectures)		4	4
	Tutorial/Exercises		1	1
	TOTAL		**5**	**5**
COURSE UNIT TYPE	Specialized knowledge/Skills development			
PREREQUISITES	Digital Image Processing			
LANGUAGE OF INSTRUCTION/EXAMS	Greek			
COURSE DELIVERED TO ERASMUS STUDENTS	No			
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE148/			

(2) LEARNING OUTCOMES

Learning Outcomes

Upon successful completion of the course, the student will be able to:

- Understand the theoretical background required for the development of computer vision applications based on the knowledge acquired.
- Perceive the requirements and complexity of a computer vision application.
- Independently apply and implement computer vision algorithms in laboratory exercises aimed at real-world problems.
- Analyze specific problems and propose appropriate solutions by combining theoretical knowledge and programming techniques, especially within the context of laboratory exercises.
- Synthesize knowledge and algorithms to solve more complex problems (e.g., image alignment or face recognition).
- Develop skills to evaluate existing tools and results within the context of individual laboratory exercises, as well as to derive/justify the results.

General Skills

- Search, analysis, and synthesis of data and information, using the necessary technologies.
- Autonomous work
- Teamwork
- Search, analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Promoting liberal, creative and inductive/deductive thinking
- Work in an interdisciplinary environment

(3) SYLLABUS

The course on Computer Vision aims to provide students with theoretical knowledge and practical training for the automatic extraction and analysis of useful information from an observed image, set of images, or sequence of images. The applications of computer vision range from robot guidance to automated inspection (counting, verification, quality control) and even medicine.

Theoretical Lecture Topics:

- Introduction: Cameras and color: pinhole camera, aperture, depth of field, field of view, lenses, filters, color formation, color spaces.
- Algorithms for labeling connected regions and shape description using statistical moments, chain codes, and image morphology.
- Edge detection in images using Sobel filters, Prewitt filters, Roberts filters, smoothing, Laplacian of Gaussian, Canny algorithm.
- Morphological filters: erosion, dilation, opening, closing.
- Detection of corners and points of interest, Harris method. Hough transform for lines and circles. Model fitting with least squares, RANSAC.
- Epipolar geometry, depth estimation, and 3D reconstruction.
- Transformations and alignment. Image alignment using similarity functions.
- Image segmentation with automatic thresholding, Otsu algorithm, region growing, and k-means algorithm.
- Face recognition using principal component analysis (PCA).

Laboratory Exercises:

- Familiarization with the use of Python/Octave for image processing and computer vision.
- Implementation examples of all topics presented in theory with student participation.

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	▪ Use of ICTs in lecturing ▪ Use of ICTs in Lab work ▪ Use of ICTs for the communication with students via the e-class platform
TEACHING ORGANIZATION	

Method description/Activity	Semester Workload
Lectures	40
Lab participation	30
Homework	40
Lab assignment	20
Course assignments	20
Total Contact Hours	**150**

ASSESSMENT METHODS	All announcements for the course are posted in the course web page. The course grade incorporates the following evaluation procedures:

	1. Written final examination (50 %) • Problem solving. • Short answer questions • Multiple choice 2. Lab project (report and oral exam) 30% 3. Weekly assignments (20%) The evaluation criteria will be announced each year on the beginning of the semester.

(5) RECOMMENDED BIBLIOGRAPHY

Books:

1. *Επεξεργασία εικόνας, Ν. Παπαμάρκος 2013*
2. *Computer Vision - A Modern Appr. 2nd ed. - D. Forsyth, J. Ponce (Pearson, 2012)*
3. *Computer Vision: Algorithms and Applications Richard Szeliski, 2010*

Journals:

1. *International Journal of Computer Vision*
2. *Computer Vision and Image Understanding*
3. *IEEE Transactions on Pattern Analysis and Machine Intelligence*