COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
ACADEMIC UNIT	INFORMATICS & TELECOMMUNICATIONS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ΕΠ10	**SEMESTER**	7
COURSE TITLE	DIGITAL IMAGE PROCESSING		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).		

COURSE TYPE *general background, special background, specialised general, knowledge, skills development*	Special background
PREREQUISITE COURSES:	NO
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/DI665/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The aim of the course is to familiarize students with modern computer methods in image processing and to enable them to implement them. Upon successful completion of the course, the student will

be able to:

1. **(Knowledge)** Explain and compare the central concepts of digital image processing (sampling/quantization, representation, space-frequency domain), describe the basic transforms (2D DFT/FFT, 2D DCT), and place filtering operations within the formal framework of linear and nonlinear systems.
2. **(Knowledge/Skill)** Formally define 2D convolution/correlation and apply linear and nonlinear filters in both the spatial and frequency domains.
3. **(Skill)** Enhance image quality using appropriate intensity transformations, histogram equalization, and anisotropic diffusion, selecting suitable parameters and documenting their impact on perception and noise.
4. **(Competence)** Estimate distortion and restore images using inverse filtering and the (adaptive) Wiener filter.
5. **(Knowledge/Skill)** Detect edges and employ the Hough transform (for lines/circles) within complete preprocessing-analysis pipelines using the OpenCV library, and thoroughly describe the operation, rationale, and principles of these algorithms.
6. **(Knowledge/Skill)** Analyze texture with statistical descriptors and spectral/directional Gabor filters, selecting appropriate features for downstream analysis or classification.
7. **(Knowledge/Skill)** Apply mathematical morphology to binary and grayscale images, understanding the role of structuring elements and integrating morphology into a sequence for cleaning, structure extraction, and image segmentation.
8. **(Competence)** Design and apply, as appropriate, segmentation methods (discontinuity detection, thresholding, region merging/splitting/growing, connected-component analysis, watershed transform), addressing practical issues such as oversegmentation and post-processing.
9. **(Knowledge/Skill)** Explain, apply, and compare basic image compression methods, evaluating result quality with appropriate metrics.
10. **(Competence)** Implement reproducible laboratory experiments and small image processing applications in Python, clearly documenting design choices.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Decision-making

Working independently

Team work

Working in an international environment

Working in an interdisciplinary environment

Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking ……

Others…

- Search for, analysis and synthesis of data and information, with the use of the necessary technology.

- Decision-making.

- Working independently.

(3) SYLLABUS

- Components of digital image processing systems and fundamental concepts (e.g., quantization, sampling, noise, color spaces and models, resampling, etc.).

- Basic two-dimensional transforms and image representations (e.g., 2D Fourier, DCT, etc.).

- Image enhancement (intensity transformations, anisotropic diffusion, histogram equalization, pseudocoloring, halftoning, spatial filters, frequency filters).

- Image restoration.

- Texture analysis.

- Mathematical morphology.

- Image segmentation methodologies (discontinuity detection, Hough transform, thresholding, region growing, connected-component analysis, watershed trasnform).

- Image compression.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of the learning process through *e-class* Contact through e-mail Use of Python programming language
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	39
Lab practice	13
Intermediate programming project	35
Final programming project	35
Preparation for final exam	30

	Course total	***152***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open- ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The course will be assessed in two complementary ways: A) An individual final exam, held during the semester's examination period. B) Two individual programming problem sets, to be submitted at mid-semester and at the end of the semester. They will be graded via a brief, in-person oral examination of each student on their deliverable, which will include code and a written report. The examination will be accompanied by a discussion of the issues encountered and the implementation approach. The final grade for each student will be the sum of the A and B components.

(5) ATTACHED BIBLIOGRAPHY

- *Digital Image Processing*, 4th Edition, R. Gonzalez and R. Woods, Ed. Tziolas, 2018 (Greek).
- *Digital Image Processing*, 3rd Edition W. Burger and M. J. Burge, Ed. Fountas, 2024 (Greek).
- *Image Processing and Analysis*, G. Tziritas and N. Komodakis, Kallipos, 2023.