COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	COMPUTER ENGINEERING AND INFORMATICS		
LEVEL OF STUDIES	UNDERGRADUATE, ELECTIVE		
COURSE CODE	CEID_NE4828	**SEMESTER**	**Spring**
COURSE TITLE	DIGITAL IMAGE PROCESSING AND ANALYSIS		

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**
Lectures and tutorials, Laboratory Exercises	3, 2	5
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	TOTAL	5

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background skills development
PREREQUISITE COURSES:	Recommended prerequisite courses: • Probability and Basic Statistics (CEID_NY204) • Signals and Systems Theory (CEID_NY282) • Digital Signal Processing (CEID_NY381)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. In case of foreign students attending the course, relevant material is available in English. Also, the examination of exercises and oral exams will be conducted in English.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/CEID1033/

(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*

A. Theory

The student that will successfully attend the course, will be able to:

- describe the basic structure and the main subsystems of an Image Processing and Analysis System
- describe a generic image acquisition system and the relevant degradations it may introduce
- understand the basic concepts of 2-D signal processing and know the main 2-D transforms
- analyze a specific image processing problem and suggest suitable methods for:
  - image enhancement
  - image restoration
  - image compression
- analyze a specific image analysis application and suggest suitable methods for:
  - edge detection and linking
  - segmentation
  - shape description and representation
  - object recognition
- know main principles of color theory and understand the particularities of color image processing and analysis.

B. Laboratory exercise

The student that will successfully complete the laboratory part of the course, will be able to:

- simulate and study a generic image acquisition system
- simulate and study basic 2-D signal processing transforms
- implement main image processing techniques for: enhancement, restoration, compression (both lossless and lossy)
- implement and study algorithms for: edge detection, region segmentation
- implement and study algorithms for shape description and object recognition.

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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

(3) SYLLABUS

A. Lectures

During the course, the following material, among others, will be covered:

- Introductory concepts for Image Processing & Analysis and their applications
- Basic elements of 2-D signal processing and image transforms
- Image acquisition systems and different types of degradation
- Image enhancement methods
- Image restoration methods
- Techniques for lossless and lossy image compression
- Reconstruction of 3D objects based on 2D projections
- Edge detection and linking
- Image segmentation
- Shape description and representation
- Object recognition
- Basic structure of an image analysis system
- Elements of color theory and color image processing basics.

B. Laboratory exercises and project

Exercises:

- Exercise 1: Image transforms and image filtering in the frequency domain
- Exercise 2: Image quantization (scalar and vector)
- Exercise 3: Image compression using DCT trnasform
- Exercise 4: Histogram based image processing
- Exercise 5: Image restoration (inverse filering, Wiener filtering)
- Exercise 6: Edge detection.

Project:

- Each student will choose to implement one from a list of possible projects.

(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*	Extensive use of ICT tools. In particular: • Web site (university e-class platform) with material for the lectures, the tutorial exercises and the laboratory exercises. • Maintaining a forum for technical discussions, answering questions, etc. • Contact with students either via the Forum or via email. • Electronic announcements and notifications via email. • Via the open class version of the course, there is additional material available.
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*	see table below
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.*	Performance evaluation is based on: • Written or oral examination (50% of the final grade) • Laboratory exercises (25% of the final grade) • Laboratory project (25% of the final grade)

Activity	***Semester workload***
Lectures	26 hours
Tutorials	13 hours
Studying during the course	26 hours
Implementation of laboratory exercises	60 hours
Preparation and participation in exams	25 hours
Course total	***150 hours***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- «Digital Image Processing», R. Gonzalez and R. Woods, Pearson, 4th edition, 2017.
- «Digital Image Processing and Analysis», N. Papamarkos, Edition 2013 (in Greek)

- Related academic journals and conferences:

- IEEE Transactions on Image Processing
- IEEE Transactions on Signal Processing
- IEEE Signal Processing Magazine
- ELSEVIER - EURASIP Image Communication Journal
- IEEE ICIP, IEEE ICASP, IEEE Globalsip, Eusipco