COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Engineering</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Computer Engineering &amp; Informatics</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
<td>NY471</td>
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<tr>
<td>SEMESTER</td>
<td></td>
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<tr>
<td>COURSE TITLE</td>
<td>Topics on Computer Vision</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th></th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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</thead>
<tbody>
<tr>
<td>Lectures and tutorials</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory exercises</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

<table>
<thead>
<tr>
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<tr>
<td>Specialised general knowledge</td>
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<tr>
<td>Skills development</td>
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PREREQUISITE COURSES:

- Signal and Systems Theory (NY282)
- Digital Signal Processing (NY381)
- Linear Algebra (NY110)
- Digital Image Processing (NE4828)
- Programming in Python

LANGUAGES OF INSTRUCTION and EXAMINATIONS:

- Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS

- No

COURSE WEBSITE (URL)

- https://eclass.upatras.gr/courses/CEID1118/

(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 goal of the elective course is the students to acquire the knowledge required to create an appropriate background that could potentially be used in the fields of computer vision and graphics, two complementary fields. Upon successful completion of the course a student will be able to:

- recognize and describe both the theoretical and practical aspects of computing with images.
- connect issues from computer vision to human vision
- become familiar with the major technical approaches involved in computer vision.
- understand the fundamental problems of computer vision
- use mathematical models and algorithms to solving them
- describe various methods used for registration, alignment, and matching in images.
- build computer vision applications.
- implement the algorithms in the environment of MATLAB, Python OpenCV, Python OpenCV, Pytorch and Tensorflow

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 | Others... |
| 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. Theory
- Computer vision, Image formation and optical sensors
- Elements from projective geometry, camera’s calibration, linear and nonlinear estimation of intrinsic and external camera’s parameters
- Photogrammetry, shadows and colors
- Parametric curves and surfaces
- Multidimensional signals and systems. Multidimensional linear spatio-temporal systems, Multidimensional filters, filters Gabor, wavelets, Scale-space decomposition, pyramids
- Stereopsis and Multiview geometry, scene reconstruction using two and multiple images
- Image matching and alignment, geometric and photometric distortions, Modeling geometric distortions via linear (affine) and nonlinear (homographies) transformations, mosaicking.
- Feature based Image matching, detection and extraction of features, Features based on corners, blobs, SIFT, Laplacian, DoG and SURF detectors
- Super resolution
- Motion and optical flow estimation, video stabilization.
- Machine Learning, Neural Networks, Deep Neural Nets
- Oblect Detection, Classical and Deep techniques

B. Laboratory Exercises
- Exercise 1: Basic geometric transformations and their use in the animation
- Exercise 2: Image Pyramids, Image de-noising and feature detection and extraction
- Exercise 3: Scene reconstruction using a stereo image system
- Exercise 4: Area based Image alignment and Joint alignment of set of images
- Exercise 5: Feature based Image alignment
- Exercise 6-8: Open source learning platforms pytorch and tensorflow
- Exercise 9-10: Implementation of state of the art object detection techniques

(4) TEACHING and LEARNING METHODS - EVALUATION

| DELIVERY | Face-to-face, Distance learning, etc. |
| USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY | Face-to-face |
| Use of ICT in teaching, laboratory education, communication with students | Wide use of ICT and more specifically:
  - The course is backed up by a web page providing all course material. This page is duly updated. In this page, there is also a number of videos where exercises are exemplary solved. Also there is a number of prototype exercises exemplary implemented in the environments of MATLAB, python OpenCV and python OpenGL.
  - The preferred communication method with the students is email. |

| TEACHING METHODS | Activity | Semester workload |
| The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, | Lectures | 26 hours |
| | Tutorials | 13 hours |
| | Study | 65 hours |
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 evaluation is performed in Greek language and is based on two independent parts. Specifically, a final written test that includes multiple choice questions and problem solving, and an oral one with short-answer questions.

Sample solutions to the written test are announced to provide students with a reference point for their marking. After the test marks are announced the students have the opportunity to see their mistakes and even to their grade.

The evaluation of the laboratory part is based on a face to face examination of the functionality of the algorithms that students develop and implement in the MATLAB environment.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, MIT Press, 2016 [link](http://www.deeplearningbook.org)

- Related academic journals and conferences:
  - IEEE Transactions on Pattern Analysis and Machine Intelligence
  - IEEE Transactions on Visualization and Computer Graphics
  - Elsevier Pattern Recognition Letters
  - CVPR, ICCV, ECCV, ACCV, NIPS, ICIP