# COURCE OUTLINE

## 1. GENERAL

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|---|---|---|---|
| **SCHOOL** | SCHOOL OF ENGINEERING | | |
| **DEPARTMENT** | DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING | | |
| **TYPE OF STUDIES** | ***Undergraduate*** | | |
| **COURSE CODE** | **EEE.8-2.5 & EEE.8-3.8** | **SEMESTER** | 8TH |
| **COURSE TITLE** | IMAGE PROCESSING & PATTERN RECOGNITION | | |
| **INDEPENDENT TEACHING ACTIVITIES** | | **WEEKLY HOURS OF INSTRUCTION** | **CREDITS** |
| Lectures | | 3 | 5 |
| Laboratory | | 1 | |
| Total | | 4 | |
| **TYPE OF COURSE** | Scientific Area | | |
| **PREREQUISITES:** | Digital Signal Processing, Signals & Systems | | |
| **LANGUAGE OF TEACHING AND EXAMINATION:** | Greek | | |
| **THE COURSE IS OFFERED TO ERASMUS STUDENTS** | NO | | |
| **COURSE WEBPAGE (URL)** | https://eclass.uniwa.gr/courses/EEE201/ | | |

## 2. LEARNING OUTCOMES

**Learning Outcomes**

The purpose of the course is to provide students with the principles of processing and analyzing images as two-dimensional signals, as well as introducing them to the concepts of machine learning and artificial intelligence through pattern recognition techniques. Machine learning is a domain of computational intelligence, specialized in the field of computer science, which uses techniques to enable the learning of the computer by progressively improving performance for one or more objects. Particular emphasis is placed on classical statistical approaches. In particular, the course aims to help the students understand the following concepts:

a) Basic methods of representing the digital image as well as analyzing and processing images in the field of space and spatial frequencies.

b) Basic methods of pattern recognition which is concerned with the automatic discovery of regularities in data through the use of computer algorithms and with the use of these regularities to take actions such as classifying the data into different categories.

Upon completion of this course the students will be able to perform the following:

- Comprehend the postulates of the digital image and speech signals and systems.
  - Use and understand image processing techniques including:
  - Image enhancement with histograms and transforms.
  - Image understanding with emphasis to feature extraction.
- Apply pattern recognition techniques with emphasis to Bayes methods.

**General Competences**

The course will introduce the students to the basic concepts and techniques for processing, analysing and understanding systems and techniques about digital image, and pattern

recognition. By the end of the course, students will become familiar with the most important methods in the above topics. The course includes topics such as image fundamentals, image enhancement, probability theory and Bayesian approaches in statistical pattern recognition. The course emphasizes to intuitive understanding and practical implementations of the theoretical concepts: The **Matlab** and **Octave** programming language, will also be used in the laboratorial part of the course. As a result, the following skills are endorsed:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking

## 3. COURSE CONTENTS

- Digital Image postulates: Chromatometry (1 week).
- Basic image processing techniques. (3 weeks).
- Image enhancement. Histogram and Frequency Domain representation. (3 weeks).
- An introduction to probabilities (1 Week).
- Principles of Pattern Recognition. (4 weeks).
- Machine learning tools: SVD, PCA, LDA (1 week).

## 4. TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **METHOD OF INSTRUCTION** | **Teaching methods include:**<br>• Teaching using traditional lecture material (**i**nteractive teaching with the students) or modern (using video projector and presentations.<br>• Use of Internet in order to acquire all the necessary information which will be used mainly in laboratorial projects.<br>• Use of the MATLAB suite in order to present various applications of theory in order to provide a comprehended and visualized framework.<br>**Student's activities include:**<br>• Solving exercises in classroom and in their personal time (groups of exercises) in order to enhance their efficiency.<br>• Team Projects, especially in the laboratorial part of the course.<br>• Use of embedded hardware platform by Texas Instruments in order to design, develop and measure digital filters.<br>• Exams, oral or written. |
| **USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES** | **USE OF MATLAB SOFTWARE AND OPEN SOURCE OCTAVE.** |

<table>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Activity</th><th>Semester workload (hours)</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Study for lectures</td><td>78</td></tr>
<tr><td>Laboratory experiments</td><td>13</td></tr>
<tr><td>Report on lab experiments</td><td>26</td></tr>
<tr><td>Study and preparation for exams</td><td>24</td></tr>
<tr><td>Course Total</td><td>180</td></tr>
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<tr><td>STUDENT EVALUATION</td><td>Total grade= 70% theory + 30% lab<br>Theory: Mid-Term (30%) Final (70%)<br>Language: Greek<br>The assessment contains in various percentages<br>• Questions of Theory.<br>• Problems.<br>• Mixed situations.<br><br>Laboratory: Atomic or small group projects (30%), Final examination (70%)<br>Language: Greek</td></tr>
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## 5. LITERATURE – SUGGESTED READING

**Essential Reading - Literature**

1. **Nikolaos Papamarkos**: Digital Image Processing, **ISBN:** 9789609273138 (**In Greek**)
2. **Ioannis Pittas,** Digital Image Processing **ISBN**: 9789609156431 (**In Greek**)
3. **Sergios Theodoridis, P. Koutroubas**, Pattern recognition. (**In Greek**)

**Further Reading – Literature**

1. **W. K. Pratt,** Digital image processing. **ISBN:** 0471767778
2. **S. Theodoridis,** Machine Learning.
3. **R. C. Gonzalez, R. E. Woods**, Digital Image Processing.
4. **R. O. Duda, P. E. Hart, D. G. Stork**, Pattern Classification.
5. **K. Fukunaga**, Introduction to Statistical Pattern Recognition.
6. **W. K. Pratt**, Digital image processing.
7. **A. K. Jain**, Digital Image Processing.