### COURSE OUTLINE

#### GENERAL

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| **SCHOOL:** | Engineering | | | | |
| **DEPARTMENT:** | Electrical and Computer Engineering | | | | |
| **LEVEL OF STUDY:** | Undergraduate | | | | |
| **COURSE UNIT CODE:** | **7.008** | **SEMESTER** | | 7 | |
| **COURSE TITLE:** | Pattern Recognition | | | | |
| **COURSEWORK BREAKDOWN** | | | **TEACHING WEEKLY HOURS** | | **ECTS Credits** |
| Theory (Lectures) | | | 2 | |  |
| Laboratory | | | 1 | |  |
| Tutorial/Exercises | | | 1 | |  |
|  | | | 4 | | **4** |
| **COURSE UNIT TYPE:** | Specialized general knowledge/Skills development | | | | |
| **PREREQUISITES:** |  | | | | |
| **LANGUAGE OF INSTRUCTION/EXAMS:** | Greek and English | | | | |
| **COURSE DELIVERED TO ERASMUS STUDENTS** | YES | | | | |
| **COURSE WEB PAGE (URL)** |  | | | | |

#### LEARNING OUTCOMES

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| **Learning Outcomes** |
| Through lectures, homework, and laboratory experiments, students should be able to do the following upon completion of this course:   * Understand what is pattern recognition and the various methods of pattern recognition * Understand and explore pattern recognition applications. * Understand the stages of solving a pattern recognition problem. * Calculate and draw simple linear decision lines. * Design and implement a minimum distance classifier. * Calculate distance measures of vectors. * Classify patterns using similarity measures. * Classify patterns using template matching. * Know the various methods of Clustering * Apply the Single Linkage, Complete Linkage, Average Linkage algorithms to patterns in order to create clusters. * Apply Ward method to patterns in order to create clusters. * Apply K-means to patterns in order to create clusters. * Understand and apply Bayesian decision making * Understand Support Vector Machines * Analyze preprocessing of data, data transformation, normalization and visualization. * Design and implement simple classifiers with MATLAB * Implement a classifier using supervised learning with MATLAB * Implement hierarchical clustering using MATLAB * Implement clustering using the K-Means algorithm with MATLAB. * Applying the classifiers to a dataset, analysis and conclusions * Analyze and explore Bayes decision theory, maximum probability method * Implement and apply Support Vector Machines to classification problems |
| **General Skills** |
| * 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 |

#### SYLLABUS

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| **Description:**  This course introduces the fundamentals of statistical pattern recognition with examples from several application areas. Techniques for handling multidimensional data of various types and scales along with algorithms for clustering and classifying data will be explained. It will emphasize on feature extraction, linear classifiers, discrimination functions cluster algorithms, Bayesian decision theory and Support Vector Machines.  **Outline:**   1. **Introduction:**   Overview of pattern recognition, Pattern recognition applications, Pattern recognition methodologies.   1. **Statistical pattern recognition:**   Feature vector and feature space, Random vectors, Classifiers, Decision functions and decision regions, Discriminant functions.   1. **Simple Classifiers:**   Linear discriminants, Quadratic discriminants, Distance measures, Similarity measures, Template matching.   1. **Clustering:**   Clustering methodologies and applications, Hierarchical clustering, k-nearest-neighbor classification, Cluster validity.   1. **Bayesian Methods:**   Introduction to probability and statistics, Bayes decision theory, Maximum likelihood method, Supervised versus unsupervised learning, Bayesian parameter estimation.   1. **Support Vector Machines** |

#### TEACHING METHODS - ASSESSMENT

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| **MODE OF DELIVERY** | In-Class Face-to-Face, Laboratory exercises |
| **USE OF INFORMATION AND COMMUNICATION TECHNOLOGY** | * Use of ICTs power point lectures * Use of ICTs for the communication with students via the e-class platform * Use of ICTs for laboratory exercises with MATLAB * Use of ICTs for videotaping the lectures and be available to students |
| **EACHING ORGANIZATION** | |  |  | | --- | --- | | ***Method description/Activity*** | ***Semester Workload*** | | Lectures | 52 | | Laboratory | 26 | | Laboratory Exercises | 26 | | Non-guided personal study | 16 | | **Total Contact Hours** | ***120*** | |
| **ASSESSMENT METHODS** | * Theory 50%   + 10% Assignments   + 20% Project   + 70% Final * Laboratory 50%   + 20% Assignments   + 20% Overall performance in class   + 70% Final Project |

#### RECOMMENDED BIBLIOGRAPHY

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| ***-Recommended Bibliography:***   * ***Introduction to pattern recognition,*** George Papadourakis and John Tsagatakis, 2004 (in Greek). * ***Pattern classification,*** R. Duda, P. Hart, D. Stork, John Willey and Sons, 2000. * ***Pattern recognition and image analysis,*** E. Gose, R. Johnsonbaught, S. Jost, Prentice Hall, 1996. * ***Pattern Recognition and Computational Intelligence Techniques Using Matlab*** E. S. Gopi***,*** Springer, 2020. * ***Pattern Recognition***, [Konstantinos Koutroumbas](https://www.bookdepository.com/author/Konstantinos-Koutroumbas) , [Sergios Theodoridis, Academic Press, 2014.](https://www.bookdepository.com/author/Sergios-Theodoridis) * ***Pattern Recognition and Machine Learning,*** Christopher M. Bishop, Springer, 2006, * ***Int. Association of Pattern Recognition (IARP) Education Resources*** http://homepages.inf.ed.ac.uk/rbf/IAPR/   ***Relevant Scientific Journals:***   * *IEEE Transactions on Pattern Analysis and Machine Intelligence* * *Pattern Recognition* * *Pattern Recognition Letters* * *International Journal of Pattern Recognition and Artificial Intelligence* |