COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>ENGINEERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>COMPUTER ENGINEERING AND INFORMATICS</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE, ELECTIVE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>CEID_NE4847</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>WINTER</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>STATISTICAL SIGNAL PROCESSING AND LEARNING</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Weekly Teaching Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures and tutorials</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory Exercises</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

Special background skills development

PREREQUISITE COURSES:

- Probability and Basic Statistics (CEID_NY204)
- Linear Algebra (CEID_NY110)
- 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/CEID1051/

(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:

- understand the basic principles of stochastic processes
- know the available detection approaches
- know the available parameter and signal estimation approaches
- implement basic detection and estimation methods
- evaluate the suitability of an estimator for a particular engineering problem
- implement basic adaptive algorithms for specific applications
- know the available, basic methods for supervised and unsupervised learning
- implement basic methods for supervised and unsupervised learning

B. Laboratory exercise

The student that will successfully complete the laboratory part of the course, will be able to:
simulate and study basic detection techniques

simulate and study basic estimation techniques for applications like:
  o system identification
  o power spectrum estimation
  o channel estimation and equalization
  o parameter tracking in time varying systems

simulate and study basic techniques for supervised and unsupervised learning

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... |

(3) SYLLABUS

A. Lectures
During the course, the following material, among others, will be covered:
  • Overview of basic principles of stochastic processes.
  • Elements of detection theory.
  • Elements of estimation theory: Parameters.
  • Elements of estimation theory: Signals.
  • Focus on estimators utilizing second-order statistics, Wiener Estimator.
  • Recursive estimation techniques, basic recursive algorithms.
  • Power spectrum estimation.
  • Space-time processing with constraints (LCMV)
  • Examples:
    o Blind system identification.
    o Channel estimation and equalization.
  • Elements of the theory of statistical learning.
  • Basic methods for supervised learning
  • Basic methods for unsupervised learning

B. Laboratory exercises
  • Exercise 1: Implementation and comparative performance study of power spectrum estimation techniques.
  • Exercise 2: Implementation and performance study of system identification techniques.
  • Exercise 3: Implementation and performance study of channel estimation and equalization techniques.
  • Exercise 4: Implementation of adaptive algorithms for time varying systems.
  • Exercise 5: Implementation and performance study of techniques for supervised and unsupervised learning.
(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Extensive use of ICT tools. In particular:</td>
</tr>
<tr>
<td></td>
<td>• Web site (university e-class platform) with material for the lectures, the tutorial exercises and the laboratory exercises.</td>
</tr>
<tr>
<td></td>
<td>• Maintaining a forum for technical discussions, answering questions, etc.</td>
</tr>
<tr>
<td></td>
<td>• Contact with students either via the Forum or via email.</td>
</tr>
<tr>
<td></td>
<td>• Electronic announcements and notifications via email.</td>
</tr>
<tr>
<td></td>
<td>• Via the open class version of the course, there is additional material available.</td>
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</table>

**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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>26 hours</td>
</tr>
<tr>
<td>Tutorials</td>
<td>13 hours</td>
</tr>
<tr>
<td>Studying during the course</td>
<td>26 hours</td>
</tr>
<tr>
<td>Implementation of laboratory exercises</td>
<td>60 hours</td>
</tr>
<tr>
<td>Preparation and participation in exams</td>
<td>25 hours</td>
</tr>
<tr>
<td>Course total</td>
<td>150 hours</td>
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</table>

**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, etc.

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 (50% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals and conferences:
  - IEEE Transactions on Signal Processing
  - IEEE Transactions on Signal and Information Processing over Networks
  - IEEE Signal Processing Magazine
  - EURASIP Journal on Advances in Signal Processing
  - ICASP, GLOBALSIP, Eusipco