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>CEID_ΝΥ384</td>
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<tr>
<td>SEMESTER</td>
<td>7th</td>
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<tr>
<td>COURSE TITLE</td>
<td>DIGITAL COMMUNICATIONS</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>Lectures and tutorials, Laboratory exercises</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4(LT), 2(LE)</td>
<td>6</td>
<td></td>
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</table>

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

TOTAL 6

COURSE TYPE

Specialized general knowledge

PREREQUISITE COURSES:

Recommended prerequisite courses:

--- “Probabilities, Random Processes and Statistics Basics” (ΝΥ204)
--- “Signals and Systems” (ΝΥ282)

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS

No

COURSE WEBSITE (URL)

https://eclass.upatras.gr/courses/CEID1025/

(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. Upon successful completion of the theoretical part of the course, a student will be able to:

- Describe the basic structure and the main subsystems of a digital communications system (DCS).
- Understand the main principles of Information Theory and the fundamental limitations in information transmission through a DCS.
- Analyse the main properties of a communications channel.
- Describe the main processing and the transformations that the information sequence undergoes while passing through the main subsystems of DCS.
- Design and implement basic source coding methods (both lossless and lossy).
- Understand the main digital modulation methods and the criteria that should be taken into account when choosing a specific modulation method for a given application.
- Present the basic subsystems of an optimum receiver and explain their operation.
- Understand the main issues that arise (e.g., Intersymbol Interference) when the information signal is transmitted through a bandlimited channel.

B. Upon successful completion of the laboratory part of the course, a student will be able to:

- Simulate a digital communications systems and its basic subsystems.
- Implement algorithms for optimum scalar and vector quantization.
- Implement basic lossless and lossy source coding techniques (e.g., Huffman, ADPCM, Delta).
- Implement basic digital modulation techniques (e.g., FSK, PAM, PSK, QAM).
- Implement an optimum receiver.
- Implement the whole process of transmitting information through bandlimited channels.
- Calculate basic performance metrics (e.g. BER) for different communications scenarios.

**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 | ..... |

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

(3) **SYLLABUS**

**A. Lectures and Tutorials:**

- Basic principles of Information Theory. Fundamental limitation in information transmission. Main theorems.
- Signal transmission through AWGN channels.
- Theory of optimum receiver.
- Basic digital modulation methods: FSK, PSK, ASK, QPSK, QAM.
- Probability of error for basic digital modulation methods.
- Information transmission through bandlimited baseband channels.
- Intersymbol Interference (ISI): How ISI is introduced and how it is mitigated.
- Basic multiplexing methods.

**B. Laboratory Exercises:**

- Exercise 1: Design and implementation of scalar and vector quantizer.
- Exercise 2: Source coding using the DPCM method.
- Exercise 3: Design and implementation of passband M-PAM.
- Exercise 4: Performance evaluation of M-PAM.
- Exercise 5: Design and implementation of M-PSK and M-FSK.
- Exercise 6: Design and implementation of Information transmission through bandlimited baseband channels.
## DELIVERY

Face-to-face, Distance learning, etc.

## 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, including videos of all lectures.

## 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>39 hours</td>
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<tr>
<td>Tutorials</td>
<td>13 hours</td>
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<tr>
<td>Study – problem solving</td>
<td>30 hours</td>
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<tr>
<td>Laboratory exercises preparation and Lab report preparation</td>
<td>58 hours</td>
</tr>
<tr>
<td>Preparation for final exams</td>
<td>40 hours</td>
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<tr>
<td>Course total</td>
<td>180 hours</td>
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## 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.

The theory evaluation is performed through a final written test that includes short-answer questions and problem solving. After the test marks are announced the students have the opportunity to see their mistakes.

The evaluation for the laboratory part is based:
- on the reports that the students submit
- on oral exams whenever needed.

Performance evaluation is more specifically based on:
- Written examination (75% of the final grade)
- Laboratory exercises (25% of the final grade)
- Optional additional Lab project (with 10% bonus)

## ATTACHED BIBLIOGRAPHY

### Recommended literature:

#### Books:
- Communications Systems, G. Karagiannidis, Tziola publishing, 2017 (in Greek)

#### Journals and Conference Proceedings:
- IEEE Transactions on Communications
- IEEE Transactions on Wireless Communications
- IEEE Communications Magazine
- IEEE Signal Processing Magazine
- EURASIP Journal on Wireless Communications and Networking
- ICC, GLOBECOM, ICASP, Eusipco