

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Department of Informatics and Telecommunications		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	ΕΠ11	SEMESTER	7
COURSE TITLE	Virtual Instruments Development for Signal Acquisition and Processing (Former Title: Real-Time Digital Signal Processing Systems)		
INDEPENDENT TEACHING ACTIVITIES <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures		1	1
Laboratory Exercises		2	2
Final Project			3
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).</i>		3	6
COURSE TYPE <i>general background, special background, specialised general, knowledge, skills development</i>	• Special Background • Skills Development		
PREREQUISITE COURSES:	• Mandatory Prerequisite: Signals and Systems (K11), 3rd semester • Recommended Prerequisite: Digital Signal Processing (K32), 5th semester		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	• https://www.di.uoa.gr/en/studies/undergraduate/303 • https://eclass.uoa.gr/courses/D70/		

(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*

Upon successful completion of the course, students will be able to:

(Knowledge)

- Describe the basic operating principles and settings of signal collection and processing systems, such as sampling, conversion rate and analysis.
- Recognize the key features and capabilities of LabVIEW software in designing and managing data collection systems.
- Recall the principles of operation, interconnection and use of various sensors and converters integrated into signal collection and processing systems.
- Explain fundamental signal processing techniques, such as filtering, smoothing, and Fourier transform, to extract critical information.

(Skills)

- Apply LabVIEW software to design and develop data collection applications, creating interfaces with sensors and converters.
- Handle LabVIEW functions for recording, visualizing and analyzing signals, applying data processing techniques.
- Perform filtering and denoising procedures to improve the reliability of measurements.

(Competences)

- Evaluate the performance of signal collection and processing systems, identifying limitations and proposing improvement solutions.
- Collaborate effectively in teams to complete data collection and processing projects, developing team spirit and collaboration skills.
- Present the results of their laboratory work clearly and professionally, justifying their choices and substantiating their conclusions with scientific accuracy.

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

Respect for difference and multiculturalism

Adapting to new situations

Respect for the natural environment

Decision-making

Showing social, professional and ethical responsibility and sensitivity to gender issues

Working independently

Criticism and self-criticism

Team work

Production of free, creative and inductive thinking

Working in an international environment

Others...

Working in an interdisciplinary environment

Production of new research ideas

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently

- Team work

(3) SYLLABUS

- Theory and architecture of digital signal processing systems
- Connecting a computer to the analog world
- Pre-processing of signals
- Sensors and transducers
- Convert from analogue to digital
- Convert from digital to analog
- Data acquisition, signal reception, measurement systems, control systems
- Virtual instruments
- Filters, window functions, data customization
- Data visualization
- User interface design and development
- G programming and application development techniques (LabVIEW environment) for:
 - Process control
 - Measurement and testing applications
 - Scientific calculations
 - Digital signal processing
 - Creation of virtual measuring and control instruments

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face: In the classroom and in the lab. For the final project, students are allowed to choose to work from home.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	The delivery is made using audiovisual media, projector and slides. Support of the learning process through the open e-class online platform for the provision of basic and supplementary educational material, announcements, assignment and submission of exercises and projects, course information and outline, calendar, communication through discussions and emails. Use of special data acquisition cards installed on laboratory computers and educational portable data acquisition cards, in combination with the use of specialized NI development software LabVIEW, installed on laboratory computers (Windows PCs). Utilization of additional NI Online Training environment with the ability to attend interactive recorded lectures and presentations, videos and self-assessment training activities, such as quizzes with multiple choice questions.

	The Department covers student licenses for the software and additional training platform.
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>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.</i> <i>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</i>	The course is organized on the open e-class platform, and registration is required. The e-class includes the slides of the lectures, the notes, the hardware manuals, the LabVIEW reference and learning tutorials. the essays of the laboratory exercises, the essays of the final projects, and the submission process. The theory is presented through lectures and presentation of slides in the first lessons. During the lectures, questions and discussion are encouraged. Then, the workshops in the LabVIEW programming environment start. Students have online access to educational material in the form of books, slides, manuals, and laboratory exercises. During the workshops, they practice on individual workstations, under the supervision and instructions of the instructor. Each individual workstation is equipped with special data acquisition hardware and the LabVIEW application development environment. The presence of students in the laboratory is mandatory, and only one absence is allowed with the prospect of replenishment. During the laboratory exercises, students work independently but not in isolation, as they can ask for the teacher's help at any time. At the end of each weekly laboratory exercise, students submit the code they implemented during it to the e-class. These exercises are graded. During the workshops, cooperation between participating students is encouraged. Finally, after students become familiar in the first workshops with the LabVIEW programming environment, they are assigned, after personal consultation and exploration of interests with everyone, the final project, which is an integrated application for collecting signals/data, processing them, displaying them and using them for control, developed in the graphical programming environment they have already practiced. The topics of the projects are assigned after discussion and the preferences and suggestions of the students are taken into account. The presentation of their results takes place during the examination period in the laboratory in the presence of all participants and teachers. Students can also practice at home, on their personal computer, since they are offered online lectures, free licenses of the LabVIEW software, and the ability to borrow portable data capture cards (hardware) for their practice and assistance in implementing their final project. The final project is on an individual level, and during its development, the entire software application development lifecycle

	is followed. Two intermediate (functional and technical specifications) and a final technical report (design, development/implementation and proper operation control) are submitted. <table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Theory</td><td>13 hr</td></tr><tr><td>Laboratory Exercises</td><td>39 hr</td></tr><tr><td>Project</td><td>98 hr</td></tr><tr><td>Course total</td><td>150 hours</td></tr></table>	Activity	Semester workload	Theory	13 hr	Laboratory Exercises	39 hr	Project	98 hr	Course total	150 hours
Activity	Semester workload										
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STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>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</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Students are evaluated based on the laboratory exercises they submit to eClass on set deadlines, and on the final project (project). The laboratory exercises contain programming code and receive complete grades as long as they work as expected according to the guidelines of each exercise and if the user interface resembles that of the guidelines. The final project is evaluated based on the two intermediate; and the final technical reports and on the application code submitted by the students to the eClass. The public presentation of each project is mandatory in front of their fellow students; the basic condition is that the application works in real-time, and the oral examination takes place during the presentation. The final project is evaluated according to graded criteria that are announced to the students. These include: Proper functioning of the code (25%), Expected functionality of the application (25%), Completeness of the technical reports (20%), Quality of the user interface (20%), Presentation (10%). Complaints and rescoring are possible. <table><tr><th>Evaluation</th><th>Number</th><th>Percentage</th></tr><tr><td>Laboratory Exercises</td><td>30</td><td>20%</td></tr><tr><td>Final project</td><td>1</td><td>80%</td></tr></table>	Evaluation	Number	Percentage	Laboratory Exercises	30	20%	Final project	1	80%	
Evaluation	Number	Percentage									
Laboratory Exercises	30	20%									
Final project	1	80%									

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- K. Kalovrakis "LabVIEW for Engineers" 3rd edition (in Greek). A. Tziola Publications, 2013. ISBN 9789604184484, code EUFOXUS 33155982. [Physical Book]
- S. Sumathi, P. Surekha "LabVIEW based Advanced Instrumentation Systems", HEAL-Link Springer ebooks, 2007. ISBN 9783540485018, code EUFOXUS 177701. [Digital Book]
- G. Kouroupetroglou "Courses in Digital Signal Processing Systems in Real Time" (in Greek). Athens, 2004. [Available in digital form in e-class]

- *Related academic journals:*

[IEEE Transactions on Signal Processing](#) (IEEE)

[Signal Processing](#) (Elsevier)

[IEEE Signal Processing Letters](#) (IEEE)

[Digital Signal Processing](#) (Elsevier)

[IEEE Transactions on Circuits and Systems I: Regular Papers](#) (IEEE)

[IEEE/ACM Transactions on Audio, Speech, and Language Processing](#) (IEEE/ACM)

[International Journal of Adaptive Control and Signal Processing](#) (Wiley)