<table>
<tr><th>module title
module code</th><th colspan="3">level of module</th><th>year of study</th><th>semester/trimester when the module is delivered</th></tr>
<tr><td>Electronic Design and Hardware Architectures
IES-A3</td><td colspan="3">MSc Level</td><td>1st</td><td>FALL semester</td></tr>
<tr><th>Name / e-mail of lecturer(s)</th><th colspan="2">Weekly Hours</th><th rowspan="2">ECTS</th><th rowspan="2">module type (comp., opt.)</th><th rowspan="2">mode of delivery (face to face, distance learning)</th></tr>
<tr><td rowspan="2">Prof.
Efstathios KYRIAKIS-BITZAROS
(mpitz@teipir.gr)
Assoc. Prof.
Stelios POTIRAKIS
(spoti@teipir.gr)</td><th>Lect.</th><th>E-learning</th></tr>
<tr><td>4</td><td>2</td><td>9</td><td>compulsory</td><td>face to face & e-learning</td></tr>
<tr><td>module web Page</td><td colspan="5">http://digilab.teipir.gr/index.php/edu/edu-msc?id=72</td></tr>
<tr><td>learning outcomes</td><td colspan="5">Upon successful completion of the course, the student possesses advanced knowledge, skills and competences that enable him/her to:
1. Analyze and design digital electronic circuits.
2. Analyze and design analog electronic circuits.
3. Design mixed signal electronic systems.
4. Design electronic systems both at printed circuit board (PCB) level and integrated circuit (IC) level.
5. Recognize and comprehend electronic components' parameters and characteristics, in the form they are provided in vendors' datasheets.
6. Choose the appropriate electronic components / ICs depending on the application of interest.
7. Confront a variety of practical issues concerning the design of an electronic system.</td></tr>
<tr><td>prerequisites and co-requisites:</td><td colspan="5">N/A</td></tr>
<tr><td>recommended optional programme components</td><td colspan="5">N/A</td></tr>
<tr><td>module description</td><td colspan="5">This module deals with advanced topics related to the design of electronic systems both at the printed circuit level, using discrete electronic components, and the integrated circuits level. It is organized in nine (9) teaching units where the subjects related to analog and digital electronics are taught in parallel.

UNIT 1 2 x 2h lectures Introduction – Structure of a Full Electronic System

The introduction to this module determines the subsystems of a full electronic system. A special reference to the particularities of the corresponding subsystems as these result</td></tr>
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			from factors such as the degree of integration that incorporate, the commercial availability of ready subsystem hardware, operating frequencies, sensitivity to noise and signal distortion, operation power, and environmental operating conditions. Finally the targets, the content and organization of the module in teaching units are summarized.
	UNIT 2	5 x 2h lectures	**Digital electronics design** In unit 2 the basic building blocks of combinational and sequential circuits are initially presented. Analysis of arithmetic units such us adders, subtractors, multipliers and divisors is performed and finally the design of a complete datapath including the control unit and the data storage is introduced. In parallel, the use of VHDL for circuit modeling, simulation and implementation on Field Programmable Gate Arrays (FPGAs) is introduced.
	UNIT 3	3 x 2h lectures	**Processor Cores** The third unit presents the core based design methodology, which gives the ability to design complex digital systems on a single chip. Open source and free processor cores and peripherals are presented.
	UNIT 4	2 x 2h lectures	**Peripherals** In this unit the use of peripheral devices for human and environmental interfaces (e.g., USB, Wi-Fi, Zigbee, memory chips, ADC, display and sensors) is studied and complete application systems are analyzed.
	UNIT 5	2 x 2h lectures	**System Implementation** In the fifth unit the implementation technologies of digital systems and systems-on-chip are discussed. The features and the pros and cons of alternative methodologies using CPLDs, FPGAs, VLSI Application Specific Integrated Circuits (ASICs) as well as micro-electro-opto-mechanical systems (MOEMS) are examined.
	UNIT 6	4 x 2h	**Analog Electronics Topologies**

		lectures	The operation of basic topologies of analog electronic stages / building blocks, which are used either at the level of circuit implementation by discrete components or at the level of integrated circuits is analyzed in unit 6. Finally, the composition of a full operational amplifier and a full audio frequencies amplifier employing the analyzed building blocks are presented.
	UNIT 7	4 x 2h lectures	**Operational Amplifiers** Unit 7 is dedicated to operational amplifiers (OpAmps) and their applications. First, the theory of operation of both the ideal and the real OpAmp is presented and different OpAmp architectures are compared, while a familiarization to the basic OpAmp parameters / characteristics in the form they are provided in vendors' datasheets is pursued. Then, OpAmp circuits and applications are studied, focusing on both their theory of operation and practical design issues.
	UNIT 8	2 x 2h lectures	**Analog to Digital and Digital to Analog Conversion (ADC-DAC)** In unit 8, the signal conversions from analog to digital (ADC) and from digital to analog (DAC) are studied. The main ADC and DAC architectures are presented, their performances are compared, while selection criteria on application basis is discussed. A familiarization to the basic ADC/DAC parameters / characteristics in the form they are provided in vendors' datasheets is pursued.
	UNIT 9	2 x 2h lectures	**PCB Level Mixed Signal Electronic Systems Design Principles** The principles for a successful design of a mixed (both analog and digital) signal electronic system at PCB level, which includes many different subsystems (power, low level analog signal, high speed digital and radio frequencies (RF) electronics) are reviewed in unit 9.
	In parallel with lecturing, practice and / or laboratory exercises, for both analog and digital electronic circuits are implemented, aiming		

	at a better understanding and consolidation of the syllabus of the module. In the frame of these exercises, the students are required to submit individual or group reports and / or prototype circuits. A visit to an electronics laboratory or a hardware design industry may also be organized.
recommended or required bibliography:	*Essential reading* 1. SEDRA, A.S. and K. C. SMITH, Microelectronic Circuits, 6th Edition, Oxford University Press, 2009, ISBN-13 978-0195323030 2. PAUL R. GRAY, PAUL J. HURST, S. H. LEWIS, ROBERT G. MEYER, Analysis and Design of Analog Integrated Circuits, 5th Edition, ISBN-13: 978-0470245996 3. CLAYTON G. and WINDER S., Operational Amplifiers, 5th Edition, ISBN-13: 978-0750659147 4. KESTER W. (Ed.), The Data Conversion Handbook, ISBN-13: 978-0750678414 5. Lecture Notes (in Greek) 6. MORRIS MANO, M., CILETTI, M., Digital Design, 5/E, 2013, Prentice Hall 7. BROWN, ST., VRANESIC, Z., Fundamentals of Digital Logic with VHDL Design, 3rd EDITION, 2009, McGrawHill. 8. KLEITZ W., Digital Electronics: A Practical Approach with VHDL, 9/E, 2012, Prentice Hall 9. MORRIS MANO, M., and KIME, C.R., Logic and Computer Design Fundamentals, Pearson Education, 4/e, 2008 10. GAJSKI D.D., Principles of Digital Design, Prentice Hall; 1/e, 1996. *Recommended Books* 1. HOROWITZ P., HILL W., The Art of Electronics, Cambridge University Press, 2006 2. FRANCO S., Design with Operational Amplifiers and Analog Integrated Circuits, 4th Edition, McGraw-Hill Science/Engineering/Math, 2014, ISBN-13: 978-0078028168 3. FLEEMAN S., Electronic Devices: Discrete and Integrated, Prentice Hall, 1990, ISBN-13: 978-0133381207
planned learning activities and teaching methods:	Lectures, Practice Sessions and Laboratory & E-learning
assessment methods and criteria:	Final exam (60%) Homework and participation (40%)
language of instruction:	Greek & English