# COURSE OUTLINE

## (1) GENERAL

| | | | |
|---|---|---|---|
| **SCHOOL** | SCHOOL OF ENGINEERING | | |
| **ACADEMIC UNIT** | DEPARTMENT OF ELECTRONICS ENGINEERING | | |
| **LEVEL OF STUDIES** | UNDERGRADUATE | | |
| **COURSE CODE** | 2606007 | **SEMESTER** | 6 |
| **COURSE TITLE** | Microelectronics - VLSI | | |

| **INDEPENDENT TEACHING ACTIVITIES** *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* | **WEEKLY TEACHING HOURS** | **CREDITS (ECTS)** |
|---|---|---|
| Lectures | 2 | 4 |
| Laboratory | 2 | |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

| | |
|---|---|
| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | Specialisation Course |
| **PREREQUISITE COURSES:** | None |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | NO |
| **COURSE WEBSITE (URL)** | http://digilab.teipir.gr/index.php/edu/edu3 |

## (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*

This is an introductory course module to VLSI technology and Integrated Circuits (ICs) aiming to:

- familiarization of students with CMOS ICs design methodologies,
- introduction to the IC implementation technologies used in microelectronics industry,
- understanding of IC evolution through the presentation of different logic families and the influence of a variety of design and fabrication parameters to circuit performance,
- familiarization with full-custom layout design of logic gates and simple digital modules in CMOS technology using IC design CAD tools.

Upon successful completion of this course module students possess advanced knowledge, skills and competences in the subject of Microelectronics and VLSI that enable them to:

1. understand and describe by drawing diagrams the operation principles and the fabrication process steps of CMOS ICs
2. know and use CAD tools for the design and simulation of CMOS ICs in logic and physical layout levels,
3. analyze, synthesize and design the physical layout of simple digital functional modules.

**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* | *……* |
| *Production of new research ideas* | *Others…* |
| | *…….* |

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work

## (3) COURSE CONTENT

*Lectures*

- Introduction to the design and architectures of VLSI Integrated Circuits
- VLSI Design methodologies and CAD tools
- CMOS IC physical layout and fabrication process steps.
- Analysis of the CMOS inverter circuit
- Design of simple and complex logic gates
- Static and dynamic logic families
- Memory elements and sequential modules. (latches flip-flops)

*Laboratory*

Ten laboratory exercises covering all module topics using university CAD tools for design and simulation of digital CMOS ICs circuits.

## (4) TEACHING and LEARNING METHODS - EVALUATION

| | |
|---|---|
| **DELIVERY** *Face-to-face, Distance learning, etc.* | Face to face lectures |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY** *Use of ICT in teaching, laboratory education, communication with students* | • Use of electronic presentation with multimedia content in class,<br>• Student support through the course webpage and the departmental e-learning platform,<br>• Electronic communication of instructors and students, through the course webpage and by e-mail.<br>• Use of software for the design and simulation of CMOS ICs in the lab. |
| **TEACHING METHODS** | Lectures, Laboratory experiments-design project and study. |

*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*

| ***Activity*** | ***Semester workload (hours)*** |
|---|---|
| Lectures | 26 |
| Study for lectures | 26 |
| Laboratory experiments – design project | 26 |
| Report on lab experiments | 26 |
| Study and preparation for exams | 16 |
| **Course Total** | ***120*** |

**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.*

Student evaluation is performed in the language of instruction.

Final course grade =
Lectures part grade x 60% + Laboratory part grade x 40%

The final written exam of the theoretical part of the module includes exercises and design problems of graded difficulty. The module content as well as test examples (solved and unsolved) are available to the students through the course web page. Students are allowed to bring any related book during examination.

The evaluation of the laboratory part is performed through:

- Oral or written test during lab exercise implementation (40%),
- Homework (60%)

## (5) ATTACHED BIBLIOGRAPHY


*Essential reading*

1. J.M. Rabaey, A. Chandrakasan, B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2/e, Prentice Hall.
2. WESTE, N., and HARRIS D. CMOS VLSI Design: A Circuits and Systems Perspective, 4/E, Addison-Wesley, 2011
3. KYRIAKIS-BITZAROS, E. D., Design of VLSI ICs Lab Manual.

*Recommended Books*

1. S.-M. Kang, Y. Leblebici, C.W. Kim, CMOS Digital Integrated Circuits Analysis & Design, 4th Ed., McGraw-Hill
2. BERNSTEIN, K., K.M. CARRIG, et al., High-Speed CMOS Design Styles, Kluwer Academic Publishers.