COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Department of Computer Engineering & Informatics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	NY164	SEMESTER	2nd
COURSE TITLE	Digital Design II		

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
Lectures and tutorials	3	3
Laboratory exercises	2	2
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	*Total*	5

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized general knowledge Skills development
PREREQUISITE COURSES:	Digital Design I (NY163)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	http://pc-vlsi18.ceid.upatras.gr/logic_design_ii.html

(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. Lectures and Tutorials Upon successful completion of the course, a student will be able to : (1) distinguish whether a given circuit is combinational or sequential (2) analyze a given sequential circuit and provide a state transition diagram for its operation (3) synthesize a circuit for implementing a given fsm transition diagram (4) use sequential MSI circuits for synthesizing a bigger circuit (5) understand the differences among integrated memory circuit technologies (6) implement a combinational circuit using memory. (7) implement a memory system from smaller memory integrated circuits, and (8) place a memory into a specific address range of a microprocessor. **B. Laboratory Exercises** Upon successful completion of the course, a student will be able to : (1) implement a circuit on a breadboard using simple logic gates or MSI (2) debug a circuit (3) verify the logic operation of his circuit, and (4) use the laboratory equipment for attaining experimental results.
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* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
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

- Sequential vs combinational circuits
- Synchronous (SSC) and asynchronous sequential circuits
- Sequential components : Latches vs FFs.
  - The instability problem : Setup and hold times
  - Possible implementations of a Dff
  - The rest available kinds of FFs : JK and T FF.
  - Direct inputs (synchronous vs asynchronous) and their implementation
  - The need for scan FFs.
  - D Scan FF.

- Mealy and Moore models for synchronous sequential machines. Finite state machines and their representations by state transition diagrams (STDs)
- The correspondence between FSMs and SSCs : The route from SSC to the FSM (SSC analysis) and form the FSM to an SSC (Synthesis of an SSC). The states encoding problem and the choice between a smaller circuit vs that of a safer circuit.

- Sequential MSI :
  - Registers (Parallel or serial input and output, load enable, tri-state output)
  - Multi-operation registers
  - Ripple counters
  - Synchronous counters (count enable, parallel load)
  - Designing a specific modulo counter from a binary one.

- Verilog HDL descriptions for sequential circuits
  - Sensitivity list of an instruction and aa block of instructions
  - Parallel and serial execution within an instructions block
- Structural and behavioral description of sequential components and circuits.
- Descriptions for simple and multi-operation registers
- Descriptions for counters
- Complete examples for describing and simulating SSCs
- More abstract descriptions : Mealy and Moore FSM descriptions

- Semiconductor Memories :
  - ROM memories : Operation model and architecture. 1-D and 2-D decoding and timing characteristics
  - RAM memories : Operation model and architecture. SRAM vs DRAM technologies and the refresh cycles in the latter
- Implementation of a combinational circuit by memory programming
- Building a larger memory from smaller ICs.
- Connecting a memory to a microprocessor's specific address range

- Programmable logic devices (PLDs) : OTPROMs, E^2PROMs, FLASH memory, PLAs, PALs, GALs, CPLDs, FPGAs
- Programming a design into a PLD

B. Laboratory Exercises

Exercise 1
Simple circuits using logic Gates Representation in different codes and translators among them. Arithmetic operations using binary and BCD representations.

Exercise 2
Circuit implementation using arithmetic MSIs (adders and subtractors)

Exercise 3
Implementation of a larger circuit using MSIs and ALUs.

Exercise 4
Counters

Exercise 5
Registers

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Wide use of ICT and more specifically : ▪ The course is backed up by a web page for the lectures and the tutorials and a second e-class page providing all necessary documentation for the laboratory exercises. Moreover laboratory implementation guidelines and sample videos of the expected functionality are provided. Both pages are duly updated. ▪ The preferred communication method with the students is email.
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*	see table below

Activity	*Semester workload*
Lectures	26 hours
Tutorials	13 hours
Laboratory exercises	10 hours
Laboratory exercises preparation	35 hours
Report preparation	10 hours
Study	50 hours
Theory exams	3 hours
Laboratory exams	1 hour
Course total	***148 hours***

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 multiple choice questions, short-answer questions and problem solving. Sample solutions to the written test are announced so that a reference point for marking is provided. 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 functionality of the circuits implemented by the students during their lab exercise, ▪ on the quality of documenting the circuits that they try to implement via their reports and ▪ on a final practical exam in which they are asked to implement a small circuit and demonstrate its functionality.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Digital Design, Principles and Practices, Wakerly J. F.
- Digital Design, Roumeliotis M. and Souravlas S., 2nd edition
- Digital Design, Dally W. J., Harting C. R.

- Related academic journals:

- IEEE Transactions on Computers
- IEEE Transactions on Circuits and Systems
- IEEE Transactions on VLSI Systems
- IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems