**COURSE OUTLINE**

1. **GENERAL**

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| **SCHOOL** | Engineering | | | | |
| **ACADEMIC UNIT** | Department of Computer Engineering & Informatics | | | | |
| **LEVEL OF STUDIES** | Undergraduate | | | | |
| **COURSE CODE** | 23Υ205 | **SEMESTER** | | 3nd | |
| **COURSE TITLE** | Computer Architecture | | | | |
| **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 | | | 4 | | 4 |
| Laboratory exercises | | |  | |  |
|  | | |  | |  |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | | ***Total*** | | **4** |
| **COURSE TYPE**  *general background,  special background, specialised general knowledge, skills development* | Specialized general knowledge  Skills development | | | | |
| **PREREQUISITE COURSES:** | Principles of Computer Systems (ΝΝΥ104)  Digital Design I (ΝΝΥ107)  Digital Design Laboratory (NNY206) | | | | |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek | | | | |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | No | | | | |
| **COURSE WEBSITE (URL)** | <https://eclass.upatras.gr/courses/CEID1407/> | | | | |

1. **LEARNING OUTCOMES**

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| **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, a student will:   1. be able to understand the differences among structure, organization, implementation, and architecture 2. describe the units that constitute a computer and their operation 3. select the correct way for data representation in a computer 4. be able to avoid problems stemming from the processing of arithmetic data 5. be able to classify processors according to their instruction set 6. be able to use the correct addressing modes 7. be able to describe the input-output process 8. know the differences between polling, interrupts, and direct memory access based input-output 9. know the technologies used for the implementation of the memory system and their characteristics 10. be able to design a main memory system satisfying given specifications 11. be able to design a data path and its control unit for each one of the following cases: 12. each instruction is executed in one clock cycle 13. an instruction is executed in several clock cycles depending on its complexity 14. be able to estimate the performance of a pipeline processor considering its characteristics 15. be able to design a pipeline processor with specific given characteristics 16. understand the operation of the processor cache memory and make the correct decisions for its design 17. be able to consider the application and the organization of the processor cache memory, to organize the data in the memory in such a way that the execution time is reduced 18. know the parameters affecting the performance of a computer system | |
| **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…*  *…….* |
| Adapting to new situations  Decision-making  Working independently  Team work  Working in an international environment  Production of new research ideas | |

1. **Syllabus**

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| Introduction: Hardware, software, Computer architecture, Instruction set, Computer structure and organization, input and output units, and input/output process.  Central processing unit:  Data path, constant point unit (ALU, register file, shifter, multiplier, divider), floating point unit, control unit (structure and implementation), Data path and control unit design (single-cycle implementation, multi-cycle implementation).  Pipelining:  Organization, Performance, structural, data and procedural hazards, hazard solution techniques, NOP instructions, pipeline stages stall, bypassing, delayed branch instructions, branch prediction techniques, static prediction techniques, dynamic prediction techniques, pipeline data path design.  Memory system:  Memory technology (semiconductor, magnetic, optical memories), Cache memory (fetch policies, organization, replace policies, update policies), Virtual memory, Implementation (paging, segmentation, segmentation, and paging), Translation Lookaside Buffer (TLB), Cache memory in the virtual and in the physical address space, Main memory implementation, Memory hierarchy.  Computer performance. |

1. **TEACHING and LEARNING METHODS - EVALUATION**

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| **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. More specifically:   * The course is backed up by a web page providing all necessary documentation * 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* | |  |  | | --- | --- | | ***Activity*** | ***Semester workload*** | | Lectures | 26 hours | | Tutorials | 26 hours | | Study | 65 hours | | Theory exams | 3 hours | | ***Course total*** | ***120 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 the Greek language.  The evaluation is performed through a final written test that includes multiple-choice questions, short-answer questions, and problem-solving. After the test marks are announced, the students have the opportunity to see their mistakes. |

1. **ATTACHED BIBLIOGRAPHY**

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| *- Suggested bibliography:*   * Computer Architecture, Dimitrios Nikolos, 1st edition 2017, in Greek * Computer Organization and Design: The Hardware/software Interface, Vol.1, 2010, D. A. Patterson, J. L. Hennessy, in Greek   *- Related academic journals:*   * IEEE Micro * IEEE Transactions on Computers * IEEE Transactions on VLSI Systems * IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems |