# SYLLABUS

## 1. Data about the program of study

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| 1.1 Institution | The Technical University of Cluj-Napoca |
| 1.2 Faculty | Faculty of Automation and Computer Science |
| 1.3 Department | Computer Science |
| 1.4 Field of study | Computer Science and Information Technology |
| 1.5 Cycle of study | Bachelor of Science |
| 1.6 Program of study/Qualification | Computer science/ Engineer |
| 1.7 Form of education | Full time |
| 1.8 Subject code | 31. |

## 2. Data about the subject

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| 2.1 Subject name | ***Structure of Computer Systems*** | | | | |
| 2.2 Course responsible/lecturer | Prof. dr. ing. Gheorghe Sebestyen – Gheorghe.Sebestyen@cs.utcluj.ro | | | | |
| 2.3 Teachers in charge of seminars/ laboratory/ project | Conf.dr.ing. Anca Hangan, S.l.dr.ing. Madalin Neagu ing. Tudor Coroian | | | | |
| 2.4 Year of study | III | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V - verification) | E |
| 2.7 Subject category | *DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară* | | | | DD |
| | *DI – Impusă, DOp – opțională, DFac – facultativă* | | | | DI |

## 3. Estimated total time

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 5 | of which: | Course | 2 | Seminars | | Laboratory | 2 | Project | 1 |
| 3.2 Number of hours per semester | 70 | of which: | Course | 28 | Seminars | | Laboratory | 28 | Project | 14 |
| 3.3 Individual study: | | | | | | | | | | |
| (a) Manual, lecture material and notes, bibliography | | | | | | | | | | 20 |
| (b) Supplementary study in the library, online and in the field | | | | | | | | | | 17 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 15 |
| (d) Tutoring | | | | | | | | | | 0 |
| (e) Exams and tests | | | | | | | | | | 3 |
| (f) Other activities: | | | | | | | | | | 0 |

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| 3.4 Total hours of individual study (suma (3.3(a)…3.3(f))) | 55 |
| 3.5 Total hours per semester (3.2+3.4) | 125 |
| 3.6 Number of credit points | 5 |

## 4. Pre-requisites (where appropriate)

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| 4.1 Curriculum | Digital system design, Computer architecture |
| 4.2 Competence | Understand and operate with basic concepts regarding computer system's hardware |

## 5. Requirements (where appropriate)

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| 5.1. For the course | |
| 5.2. For the applications | |

## 6. Specific competence

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| 6.1 Professional competences | **C2** – Designing hardware, software and communication components (5 credits)<br>**C2.1** – Describing the structure and functioning of computational, communication and software components and systems<br>**C2.2** – Explaining the role, interaction and functioning of hardware, software and communication components<br>**C2.3** – Building the hardware and software components of some computing systems using algorithms, design methods, protocols, languages, data |

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| | structures, and technologies<br>**C2.4** – Evaluating the functional and non-functional characteristics of the computing systems using specific metrics<br>**C2.5** – Implementing hardware, software and communication systems |
| 6.2 Cross competences | N/A |

**7. Discipline objective (as results from the *key competences gained*)**

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| 7.1 General objective | The main goal of the course is to present in an accessible way advanced design methods and techniques used in today's microprocessors and computer systems |
| 7.2 Specific objectives | To study:<br>Methods and metrics for computer performance assessment<br>Advanced CPU designs (pipelining, multicore, parallele and distributed computing)<br>Memory hierarchies: cache memory, virtual memory, new DRAM technologies<br>RISC architecture<br>Parallel computers architectures – hardware issues and solutions |

**8. Contents**

| 8.1 Lectures | Hours | Teaching methods | Notes |
|---|---|---|---|
| Introduction. Computer Performance Parameters and Methods of Improvement | 2 | Lecture based on slides, onsite or online (depending on the medical conditions) tools used: MS PowerPoint, Teams, Moodle | |
| Computer performance and optimality, Benchmarking | 2 | | |
| The Arithmetical and Logical Unit (ALU) | 2 | | |
| The Central Processing Unit (CPU) – MIPS architecture, pipeline, hazard cases | 2 | | |
| The Central Processing Unit – advance techniques: Scoreboard method, Tomasulo's algorithm, Branch prediction techniques | 2 | | |
| The Central Processing Unit – multi-core systems | 2 | | |
| Microprocessors – basic components and advanced implementations | 2 | | |
| Memory System – memory technologies (SRAM, DRAM) and design principles | 2 | | |
| Memory Hierarchies – cache and virtual memory | 2 | | |
| Interconnection Systems – serial and parallel synchronous and asynchronous buses, multipoint interconnections | 2 | | |
| Parallel Computer Architectures - different levels of parallel execution | 2 | | |
| RISC Architectures – principles and implementation examples | 2 | | |
| Distributed Computing – GRID and Cloud Systems | 2 | | |
| Technological Perspectives in Computer Architectures | 2 | | |

Bibliography


1. Gorgan Dorian, Sebestyen Gheorghe, Structura Calculatoarelor, Editura albastra, Cluj-Napoca 2005
2. Hennessy John, Patterson David, Computer architecture, a Quantitative Approach, Ed. Elsevier, 2007
3. Baruch, Z. F., Structure of Computer Systems, U.T.PRES, Cluj-Napoca, 2002, ISBN 973-8335-44-2.


| 8.2 Applications – Seminars/Laboratory/Project | Hours | Teaching methods | Notes |
|---|---|---|---|
| Measuring the performance of computer systems with benchmarks | 2 | Practical designs, experiments and results assessment, onsite or online (depending on the medical conditions) tools used: MS Teams, Moodle | |
| CPU performance monitoring using the Time-Stamp Counter register | 2 | | |
| Programming elements in VHDL | 2 | | |
| Design of ALU components | 2 | | |
| FPGA Synthesis | 2 | | |
| Introduction to using PicoBlaze microcontroller with the Nexys3 board | 2 | | |
| Implementation of a MIPS processor in VHDL - 1 | 2 | | |
| Implementation of a MIPS processor in VHDL - 2 | 2 | | |

| | | | |
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| Implementation of a pipelined MIPS processor in VHDL | 2 | | |
| Memory design - 1 | 2 | | |
| Memory design - 2 | 2 | | |
| Advanced Hardware Design Techniques | 2 | | |
| Design implementations on NEXYS 3 board | 2 | | |
| Laboratory Colloquy | 2 | | |
| Topics for Project Assignments: Implementation of arithmetic circuits; Design and implementation of processors and controllers; Signal Processing; Hardware implementation of DSP and image processing algorithms; Design of I/O interfaces. | | | |
| Bibliography<br>Laboratory works at http://users.utcluj.ro/~ancapop/scs.html | | | |

*Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.*

**9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field**

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**10. Evaluation**

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|---|---|---|
| Course | Theoretical knowledge level | Written exam, onsite or online (depending on the medical conditions); tools used: MS Teams, Moodle | 60% |
| Seminar | | | |
| Laboratory<br>Project | Hardware Design skills | Practical evaluation, onsite or online (depending on the medical conditions) tools used: MS Teams, Moodle | 40% |
| Minimum standard of performance:<br>Minimum 5 for the Course and for the Application assessment<br>Grade calculus: 30% midterm + 20% laboratory + 20% project + 30% final exam<br>Conditions for participating in the final exam: Laboratory ≥ 5, Project ≥ 5<br>Conditions for promotion: final grade ≥ 5 | | | |

| **Date of filling in:** | **Titulari** | **Titlu Prenume NUME** | **Semnătura** |
|---|---|---|---|
| | Course | Prof. dr. ing. Gheorghe Sebestyen | |
| | Applications | Conf. Dr. Ing. Anca Hangan<br>S.l. Dr. Ing. Madalin Neagu<br>Ing. Tudor Coroian | |

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| **Date of approval in the department** | Head of department<br>Prof.dr.ing. Rodica Potolea |
| **Date of approval in the Faculty Council** | Dean<br>Prof.dr.ing. Liviu Miclea |