# COURSE SHEET

*Distributed Computing - Principles and Algorithms*
*Academic year 2023-2024*

## 1. About the program

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|---|---|---|
| 1.1 | University | Universitatea din Piteşti |
| 1.2 | Faculty | Sciences, Physical Education and Computer Science |
| 1.3 | Department | Mathematics-Computer Science |
| 1.4 | Field of study | Informatics |
| 1.5 | Cycle of studies | Master |
| 1.6 | Study Program / Qualification | Advanced techniques for information processing/ Advanced techniques for information processing |

## 2. Discipline data

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Name of the discipline | | | | | **Distributed Computing - Principles and Algorithms** | | | | | |
| 2.2 | The holder of the course activities | | | | | Tudor Bălănescu | | | | | |
| 2.3 | Holder of laboratory activities | | | | | Tudor Bălănescu | | | | | |
| 2.4 | Year of study | 2 | 2.5 | Semester | 2 | 2.6 | Type of assessment | E | 2.7 | Discipline regimen | O |

## 3. Estimated total time

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3.1 | Number of hours per week | 4 | 3.2 | of which course | 2 | 3.3 | laboratory | 2 |
| 3.4 | Total hours of the curriculum | 48 | 3.5 | of which course | 24 | 3.6 | laboratory | 24 |

| Distribution of the time fund | hours |
|---|---|
| Study by textbook, course support, bibliography and notes | 56 |
| Additional documentation in the library, on specialized electronic platforms and in the field | 46 |
| Preparation of seminars/ laboratories, themes, papers, portfolios, essays | 40 |
| Tutoring | 6 |
| Examination | 4 |
| Other activities..... | - |

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| 3.7 | Total hours of self-study | 152 |
| **3.8** | **Total hours per semester** | **200** |
| **3.9** | **Number of credits** | **8** |

## 4. Preconditions (where applicable)

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|---|---|---|
| 4.1 | Curriculum | - |
| 4.2 | Skills | - |

## 5. Conditions (where applicable)

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|---|---|---|
| 5.1 | Conduct of the course | Room with video projector |
| 5.2 | Conducting the seminar/laboratory | Room with video projector and computer equipment |

## 6. Acquired specific skills

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| Professional skills | Operation with problems of consensus, communication, ressource allocation and synchronizarion of distributed computer suystems.<br>Skills to operate with theoretical concepts and practical methods regarding the process of design and implementation of distributed systems.<br>Knowledge of theoretical procedures for analyzing the time and communication efficiency of distributed systems.<br>Realization of it projects in a distributed context.<br>Conceiving, designing and implementing of software components distributed over a network.<br>. |
| Transversal competences | Applying the rules of organized and efficient work, of responsible attitudes towards the scientific-professional field, for the creative capitalization of one's own potential, respecting the principles and norms of professional ethics;<br>Efficiently carrying out the activities organized in an interdisciplinary team by assuming execution and leadership functions, with the development of empathic capacities of inter-personal communication, networking and collaboration with various groups;<br>Elaboration of own professional development project; the use of effective methods and techniques for learning, information, research and capacity development, for valuing knowledge, for adapting to the requirements of a dynamic society and for communicating in Romanian and English. |

## 7. The objectives of the discipline

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| 7.1 The general objective of the discipline | ▶ The discipline has as general objective the acquisition by students of the basic knowledge, as well as of the advanced methods and techniques regarding the principles and algorithms for designing distributed software systems. |
| 7.2 Specific objectives | Cognitive objectives:<br>▶ Knowledge of the timing model of distributed systems: synchronous, asynchronous or partially synchronous.<br>▶ Knowledge of the interprocess communication mechanisms: message passing and shared memory.<br>*Procedural objectives:*<br>▶ Training skills for implementing the main algorithms used in the development of distributed |

| | |
|---|---|
| | systems.<br>*Attitudinal objectives:*<br>▶ Rigor in the design, implementation and analyzing of distributed systems.. |

**8. Contents**

| **8.1. Course** | | Nr. hours | Teaching methods | Observations Resources used |
|---|---|---|---|---|
| 1 | Synchronous Network Model | 2 | lecture<br>problematization<br>algorithmization<br>debate<br>individual themes<br>group work<br>Explanation<br>Description and exemplification<br>Demonstration<br>Heuristic Conversation<br>Exercise | computer projector |
| 2 | Proof methods and complexity measures | 2 | | |
| 3 | Leader Election | 4 | | |
| 4 | Vertex Coloring | 2 | | |
| 5 | BFS Tree Construction | 2 | | |
| 6 | MST Construction | 2 | | |
| 7 | Sorting Networks | 2 | | |
| 8 | Counting Networks | 2 | | |
| 9 | Shared Memory | 2 | | |
| 10 | Communication complexity | 4 | | |

*Bibliography*

1. Nancy A. Lynch: *Distributed Algorithms.* Morgan Kaufmann Publishers*, 1996*
2. Roger Wattenhofer*: Principles of Distributed Computing,* Springer, 2016.

| **8.2. Applications – Seminar / Laboratory** | | Nr. hours | Teaching methods | Observations Resources used |
|---|---|---|---|---|
| 1 | LeLann-Chang_Roberts Algorithm | 2 | Explanation<br>Description and exemplification<br>Case study<br>Exercise<br>Problematization<br>Individual themes<br>Group work<br>Debate | Network of computers |
| 2 | Hirchsberg-Sinclair Algorithm | 4 | | |
| 3 | Breadth-First Search | 2 | | |
| 4 | Minimum Spanning Tree | 2 | | |
| 5 | Maximal Independent Set | 2 | | |
| 6 | The Coordinated Attack Problem | 4 | | |
| 7 | Dijkstra's Mutual Exclusion Algorithm | 2 | | |
| 8 | The Backery Algorithm | 4 | | |
| 9 | Dining Philosophers Problem | 4 | | |

*Bibliography*

1. Maurice Herlihy, Nir Shavit: The Art of Multiprocessor Programming, Elsevier 2008.
2. Christel Baier, Joost_Pieter Katoen: Principles of Model Checking, MIT Press, 2008

**9. Corroborating the contents of the discipline with the expectations of the representatives of the epistemic community, professional associations and employers in the field related to the program**

The competences acquired within the discipline allow the graduates to efficiently use algorithms and methodologies for design, implementation, verification and validation of distributed software systems.

**10. Evaluation**

| Activity Type | 10.1 Assessment criteria | 10.2 Assessment methods | 10.3 Percent of final grade |
|---|---|---|---|
| 10.4 Course | Final evaluation | Practical test (algorithms and problems) | 50% |
| 10.5 Seminar/ Laboratory | Activity (solving proposed problems)<br>Homework | Verification of solutions, practical test<br>Homework check | 30%<br>20% |
| 10.6 Minimum performance standard | * Marks of at least 5 for the laboratory activity, for the homework and for the final evaluation (50% solving the requirements); final grade at least 5.<br>* Set of minimal knowledge for passing the final exam:<br>- Knowledge of the main computational models studied;<br>Knowledge of ways of adequate application and efficient implementation of these models in solving the proposed problems. | | |

Date of completion 19.09.2023

Course holder
Prof.univ.dr Tudor Balanescu

Laboratory holder
Prof.univ.dr Tudor Balanescu

Date of approval in the Department 19.09.2023

Director Department (provider)
Conf.univ.dr. Doru CONSTANTIN

Director Department (*beneficiary)*)
Conf.univ.dr. Doru CONSTANTIN