# 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 | Master |
| 1.6 Program of study / Qualification | Data Science / Master |
| 1.7 Form of education | Full time |

## 2. Data about the subject

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| 2.1 Subject name | **Cloud computing** | | | Subject code | **17.10** |
| 2.2 Course responsible / lecturer | Prof. dr. eng. Ionuț Anghel - Ionut.Anghel@cs.utcluj.ro<br>Prof. dr. eng. Tudor Cioara - Tudor.Cioara@cs.utcluj.ro | | | | |
| 2.3 Teachers in charge of seminars / Laboratory / project | Prof. dr. eng. Ionuț Anghel - Ionut.Anghel@cs.utcluj.ro<br>Prof. dr. eng. Tudor Cioara - Tudor.Cioara@cs.utcluj.ro | | | | |
| 2.4 Year of study | I | 2.5 Semester | 3 | 2.6 Type of assessment (E - exam, C - colloquium, V – verification) | E |
| 2.7 Subject category | Formative category: DA – advanced, DS – speciality, DC – complementary | | | | DS |
| | Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice) | | | | DI |

## 3. Estimated total time

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 2 | of which: | Course | 1 | Seminars | - | Laboratory | - | Project | 1 |
| 3.2 Number of hours per semester | 28 | of which: | Course | 14 | Seminars | - | Laboratory | - | Project | 14 |
| 3.3 Individual study: | | | | | | | | | | |
| (a) Manual, lecture material and notes, bibliography | | | | | | | | | | 25 |
| (b) Supplementary study in the library, online and in the field | | | | | | | | | | 25 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 19 |
| (d) Tutoring | | | | | | | | | | - |
| (e) Exams and tests | | | | | | | | | | 3 |
| (f) Other activities: | | | | | | | | | | - |

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| 3.4 Total hours of individual study (suma (3.3(a)…3.3(f))) | 72 |
| 3.5 Total hours per semester (3.2+3.4) | 100 |
| 3.6 Number of credit points | 4 |

## 4. Pre-requisites (where appropriate)

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| 4.1 Curriculum | Distributed Systems |
| 4.2 Competence | Critical design and evaluation of cloud-based systems using specific concepts, techniques, and methods. Knowledge of specific architectures, deployment models and development technologies. |

## 5. Requirements (where appropriate)

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| 5.1. For the course | Computers, software specific tools |
| 5.2. For the applications | Computers, software specific tools |

**6. Specific competence**

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| 6.1 Professional competences | • analyse decentralised applications<br>• define software architecture<br>• define technical requirements<br>• design cloud architecture<br>• develop software prototype<br>• develop with cloud services<br>• interpret technical requirements<br>• manage cloud data and storage<br>• provide technical documentation<br>• use data processing techniques |
| 6.2 Cross competences | • develop an analytical approach<br>• taking a proactive approach<br>• developing strategies to solve problems<br>• being open minded<br>• coordinate engineering teams |

**7. Expected Learning Outcomes**

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| Knowledge | The student has knowledge of:<br>• cloud technologies<br>• data analytics<br>• data storage<br>• database management systems (DBMS)<br>• software components<br>• cloud technologies |
| Skills | The student is able to:<br>• design databases in the cloud<br>• develop data processing applications<br>• use data processing techniques<br>• use databases |
| Responsibilities and autonomy | The student has the ability to work independently in order to:<br>• develop an analytical approach<br>• take a proactive approach<br>• develop strategies to solve problems<br>• be open minded<br>• coordinate engineering teams |

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

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| 8.1 General objective | In-depth study of concepts, techniques, algorithms and advanced methods of specification, modelling, analysis, design, implementation and validation of complex distributed systems using Cloud architectures |
| 8.2 Specific objectives | Design, modelling, analysis, critical evaluation, design, implementation and validation of Cloud-based systems. Operating with specific concepts and techniques related to resource management, virtualization, programming models, communication, deployment and security in the Cloud. |

**9. Contents**

| **9.1 Lectures** | Hours | Teaching methods | Notes |
|---|---|---|---|
| Introduction to Cloud Computing | 1 | Blackboard, video projector presentation and Discussions | N/A |
| Cloud Service and Deployment Models | 1 | | |
| Cloud Data Center Infrastructure | 1 | | |
| Virtualization and Containerization | 1 | | |
| Data Storage in the Cloud | 1 | | |
| Cloud Communication | 1 | | |

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|---|---|---|---|
| Automation and Orchestration | 1 | | |
| Cloud Programming Models | 1 | | |
| Microservices | 1 | | |
| Serverless Computing | 1 | | |
| Cloud Resource Management | 1 | | |
| Security and Privacy in the Cloud | 1 | | |
| Edge Computing | 1 | | |
| Conclusions and Research Directions | 1 | | |


Bibliography:

1. D. Comer - The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC; 1st edition 2021, ISBN-10: 0367706806
2. D. Marinescu - Cloud Computing. Theory and Practice, 3rd Edition, Elsevier, ISBN: 9780323852777, 2022
3. T. Erl, E. B. Monroy - Cloud Computing: Concepts, Technology, Security, and Architecture, 2nd Edition. Pearson. ISBN: 9780138052256, 2023.
4. N. B. Ruparelia - Cloud Computing, Revised And Updated Edition. The MIT Press. ISBN: 9780262546478, 2023.
5. K. Chandrasekaran - Essentials of Cloud Computing, CRC Press. ISBN: 1482205432, 2015.
6. Course website


| **9.2 Applications - Project** | Hours | Teaching methods | Notes |
|---|---|---|---|
| Project topics presentations and discussions | 2 | Blackboard presentations, application presentation, thematic papers developed as a result of bibliography research, presentation with the video projector, discussions. | N/A |
| Virtualization platforms: Hyper-V / KVM / XEN | 2 | | |
| Cantainers: Docker and Docker Swarm | 2 | | |
| Container management: Kubernetes | 2 | | |
| Apache Hadoop | 2 | | |
| Apache Mesos / Apache Helix | 2 | | |
| Edge computing orchestration tools: KubeEdge | 2 | | |


Bibliography

1. R. McHaney, Cloud Technologies: An Overview of Cloud Computing Technologies for Managers, Wiley, ISBN: 978-1-119-76952-1 2021
2. Course website


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

In their undergraduate studies, students delve deeper into the design of many classes of systems including distributed systems, parallel systems, etc. This discipline aims to complement the variety of systems covered during undergraduate studies, proposing the study of a class of cloud computing and complex cloud applications that is becoming increasingly present both in the research area and in the commercial field.

**10. Evaluation**

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|---|---|---|
| Course | Ability to propose solutions to industry-specific problems. Attendance, (inter)activity during classes. | Face-to-face written exam – summative | 50% |
| Seminar | - | - | - |
| Laboratory | - | - | - |
| Project | Ability to identify problems and use existing technologies in the field. Presence, (inter)activity during classes. | Face-to-face evaluation – continuous and summative | 50% |

Minimum standard of performance:
Understanding the basic concepts of the field and demonstrating the ability to use the new technologies studied. Final grade: 50% (laboratory) + 50% (exam)
Conditions for participation in the final exam: Laboratory Note ≥ 5; Elaboration of a Research Report and its presentation.
Passing conditions: Final exam grade ≥ 5

| **Date of filling in:** 01.09.2025 | **Responsible** | **Title First name Last name** | **Signature** |
|---|---|---|---|
| | Course | Prof.dr.eng. Ionuț ANGHEL | |
| | | Prof.dr.eng. Tudor CIOARA | |
| | Applications | Prof.dr.eng. Ionuț ANGHEL | |
| | | Prof.dr.eng. Tudor CIOARA | |

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| Date of approval in the department<br>17.09.2025 | Head of department,<br>Prof.dr.eng. Rodica Potolea |
| Date of approval in the Faculty Council<br>19.09.2025 | Dean,<br>Prof.dr.eng. Vlad Mureșan |