# 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 | ***Internet of Things and Industry 4,0*** | | | Subject code | **15.10** |
| 2.2 Course responsible / lecturer | Lect.dr.eng. Raluca-Laura PORTASE - raluca.portase@cs.utcluj.ro | | | | |
| 2.3 Teachers in charge of seminars / Laboratory / project | Lect.dr.eng. Raluca-Laura PORTASE - raluca.portase@cs.utcluj.ro | | | | |
| 2.4 Year of study | II | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V – verification) | E |
| 2.7 Subject category | Formative category: DA – advanced, DS – speciality, DC – complementary | | | | DA |
| | Optionality: DI – imposed, DO – optional (alternative), DF – optional (free choice) | | | | DO |

## 3. Estimated total time

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|---|---|---|---|---|---|---|---|---|---|---|
| 3.1 Number of hours per week | 3 | of which: | Course | 1 | Seminars | 1 | Laboratory | 1 | Project | - |
| 3.2 Number of hours per semester | 42 | of which: | Course | 14 | Seminars | 14 | Laboratory | 14 | Project | - |
| 3.3 Individual study: | | | | | | | | | | |
| (a) Manual, lecture material and notes, bibliography | | | | | | | | | | 20 |
| (b) Supplementary study in the library, online and in the field | | | | | | | | | | 10 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays | | | | | | | | | | 20 |
| (d) Tutoring | | | | | | | | | | 5 |
| (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))) | 58 |
| 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 | Big Data, Machine Learning. Distributed systems - bachelor. Design with microprocessors - bachelor |
| 4.2 Competence | Operating with fundamental computer science concepts |

## 5. Requirements (where appropriate)

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| 5.1. For the course | Blackboard, Projector, PC<br>MS Teams Platform |
| 5.2. For the applications | PC, Specific Software |

**6. Specific competence**

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| 6.1 Professional competences | analyse big data<br>analyse decentralised applications<br>build predictive models<br>create data models<br>debug software<br>define software architecture<br>define technical requirements<br>develop software prototype<br>develop with cloud services<br>implement smart contracts<br>interpret technical requirements<br>perform data cleansing<br>perform data mining<br>use data processing techniques<br>use software design patterns<br>use software libraries<br>utilise computer-aided software engineering tools<br>utilise machine learning |
| 6.2 Cross competences | The graduate:<br>• develop an analytical approach<br>• taking a proactive approach<br>• developing strategies to solve problems<br>• being open minded |

**7. Expected Learning Outcomes**

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| Knowledge | The student has knowledge of:<br>• cloud technologies<br>• computer science<br>• data analytics<br>• data models<br>• data storage<br>• data warehouse<br>• digital data processing<br>• computer programming<br>• smart contracts<br>• unstructured data<br>• software components<br>• software libraries<br>• cloud technologies<br>• data analytics |

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| Skills | The student is able to:<br>• create data sets<br>• design databases in the cloud<br>• develop data processing applications<br>• establish data processes<br>• manage quantitative data<br>• manage research data<br>• perform dimensionality reduction<br>• process data<br>• use data processing techniques<br>• use databases<br>• analyse pipeline database information<br>• create data models<br>• debug software<br>• use software design patterns<br>• use software libraries<br>• adapt to changes in technological development plans |
| 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 |

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

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| 8.1 General objective | Facilitate the understanding of main characteristic of IoT system and the Internet 4.0 context. Knowledge of the algorithms, protocols and best practices. Design, implement, evaluate and integrate an IoT system |
| 8.2 Specific objectives | In order to achieve this objective, students will learn to:<br>• understanding of IoT protocols<br>• process data from IoT enviroment<br>• apply statistical methods and machine learning techniques for analysing IoT data<br>• determine and optimize parameters<br>• design systems for IoT with an increased security |

**9. Contents**

| **9.1 Lectures** | Hours | Teaching methods | Notes |
|---|---|---|---|
| IoT introduction notions. Distributed world | 1 | Lectures using blackboard and projector; involving students in debate | |
| IoT Architecture. Web of things | 1 | | |
| Wired and wireless technologies for the IoT | 1 | | |
| Industrial Protocols and Standards for Internet of Things | 2 | | |
| Intro to industrial protocols. Intro to smart cities | 1 | | |
| Data in IoT networks | 1 | | |
| Cloud & Edge Computing for IoT | 2 | | |
| Cybersecurity in IoT & Industry 4.0 | 2 | | |
| Machine learning models applied to IoT | 2 | | |
| Predictive maintenance models | 1 | | |

Bibliography:


• Hands-On Industrial Internet of Things. 2nd edition. Giacomo Veneri, Antonio Capasso, Packt Publishing Limited, 2024

• Internet of Things and Data Analytics Handbook. Hwaiyu Geng. Wiley, 2017

• Internet of Things: Architectures, Protocols and Standards. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri Wiley. 2018.

• Artificial Intelligence for IoT Cookbook: Over 70 recipes for building AI solutions for smart homes, industrial IoT, and smart cities. Michael Roshak, Packt Publishing Limited. 2021

• Practical IoT Hacking: The Definitive Guide to Attacking the Internet of Things. Fotios Chantzis, Ioannis Stais, Paulino Calderon, Evangelos Deirmentzoglou, Beau Woods. No Starch Press, 2021
• The IoT Hacker's Handbook: A Practical Guide to Hacking the Internet of Things. Aditya Gupta. APress. 2019

| **9.2 Applications - Seminars/Laboratory/Project** | Hours | Teaching methods | Notes |
|---|---|---|---|
| Introduction to IoT | 4 | Oral presentation using slides, discussions (Q&A). Using multimedia tools, interactive teaching tools. Using specific software and hardware for IoT. Lab assignments | |
| Web of things and IoT technologies | 2 | | |
| Industrial Protocols and Standards | 2 | | |
| Smart Cities & Industrial Protocols | 2 | | |
| Data storage and preprocessing | 2 | | |
| Cloud & Edge Computing for IoT | 2 | | |
| Cybersecurity for IoT | 4 | | |
| AI for IoT | 2 | | |
| Federated Learning | 2 | | |
| ML applications in IoT and Industry 4.0 context | 4 | | |
| Project presentations | 2 | | |

Bibliography

• Hands-On Industrial Internet of Things. 2nd edition. Giacomo Veneri, Antonio Capasso, Packt Publishing Limited, 2024
• Internet of Things and Data Analytics Handbook. Hwaiyu Geng. Wiley 2017
• Machine Learning for Time-Series with Python – Ben Auffart, Packt Publishing Limited 2021
• The IoT Hacker's Handbook: A Practical Guide to Hacking the Internet of Things. Aditya Gupta. APress, 2019

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

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

**11. Evaluation**

| Activity type | Assessment criteria | Assessment methods | Weight in the final grade |
|---|---|---|---|
| Course | Exam | Written Exam – summative evaluation | 50% |
| Seminar | Presentation; Demonstration | Oral examination - summative evaluation | 20% |
| Laboratory | Assignments | Evaluation of assignments during the semester – continuous evaluation | 30% |
| Project | - | - | - |
| Minimum standard of performance: Lab grade + seminar grade >=5, Course evaluation grade >=5 | | | |

| **Date of filling in:** 01.09.2025 | **Responsible** | **Title First name Last name** | **Signature** |
|---|---|---|---|
| | Course | Lect.dr.eng. Raluca Portase | |
| | Applications | Lect.dr.eng. Raluca Portase | |
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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 |