

## SYLLABUS

### 1. Data about the program of study

|                                      |                                              |
|--------------------------------------|----------------------------------------------|
| 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                   | Masters                                      |
| 1.6 Program of study / Qualification | Artificial Intelligence and Vision / Masters |
| 1.7 Form of education                | Full time                                    |

### 2. Data about the subject

|                                                           |                                                                                                                 |              |   |                                                                     |              |          |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------|---|---------------------------------------------------------------------|--------------|----------|
| 2.1 Subject name                                          | <b>Computer Networks</b>                                                                                        |              |   |                                                                     | Subject code | <b>2</b> |
| 2.2 Course responsible / lecturer                         | Prof. dr. eng. Dădârlat Vasile - <a href="mailto:Vasile.Dadarlat@cs.utcluj.ro">Vasile.Dadarlat@cs.utcluj.ro</a> |              |   |                                                                     |              |          |
| 2.3 Teachers in charge of seminars / Laboratory / project | Prof. dr. eng. Dădârlat Vasile - <a href="mailto:Vasile.Dadarlat@cs.utcluj.ro">Vasile.Dadarlat@cs.utcluj.ro</a> |              |   |                                                                     |              |          |
| 2.4 Year of study                                         | I                                                                                                               | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V – verification) | E            |          |
| 2.7 Subject category                                      | Formative category: DF – fundamental, DS – speciality, DC – complementary                                       |              |   |                                                                     |              | DF       |
|                                                           | Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)                        |              |   |                                                                     |              | DOB      |

### 3. Estimated total time

|                                                                                      |    |           |        |    |          |    |            |   |         |    |
|--------------------------------------------------------------------------------------|----|-----------|--------|----|----------|----|------------|---|---------|----|
| 3.1 Number of hours per week                                                         | 3  | of which: | Course | 2  | Seminars | 1  | Laboratory | - | Project | -  |
| 3.2 Number of hours per semester                                                     | 42 | of which: | Course | 28 | Seminars | 14 | Laboratory | - | 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 |    |           |        |    |          |    |            |   |         | 15 |
| (d) Tutoring                                                                         |    |           |        |    |          |    |            |   |         | 11 |
| (e) Exams and tests                                                                  |    |           |        |    |          |    |            |   |         | 2  |
| (f) Other activities:                                                                |    |           |        |    |          |    |            |   |         | -  |
| 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)

|                |                                             |
|----------------|---------------------------------------------|
| 4.1 Curriculum | Computer Networks – BSc level               |
| 4.2 Competence | Fundamentals of engineering and informatics |

### 5. Requirements (where appropriate)

|                           |                                      |
|---------------------------|--------------------------------------|
| 5.1. For the course       | Video projector, attendance min. 50% |
| 5.2. For the applications | Video projector, attendance 100%     |

## 6. Specific competence

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.1 Professional competences | <ul style="list-style-type: none"> <li>• analyse business requirements</li> <li>• analyse big data</li> <li>• apply ICT systems theory</li> <li>• create data sets</li> <li>• define technical requirements</li> <li>• design process</li> <li>• develop creative ideas</li> <li>• develop statistical software</li> <li>• deliver visual presentation of data</li> <li>• creatively use digital technologies</li> <li>• use data processing techniques</li> <li>• acquire system component</li> <li>• align software with system architectures</li> <li>• create data models</li> <li>• manage system testing</li> <li>• assess ICT knowledge</li> <li>• manage database</li> <li>• implement ICT security policies</li> <li>• integrate system components</li> <li>• design enterprise architecture</li> <li>• design information system</li> <li>• use an application-specific interface</li> <li>• use markup languages</li> <li>• build predictive models</li> <li>• build recommender systems</li> <li>• utilise machine learning</li> <li>• conduct scholarly research</li> <li>• develop computer vision system</li> <li>• apply statistical analysis techniques</li> <li>• manage data collection systems</li> </ul> |
| 6.2 Cross competences        | <p>The graduate:</p> <ul style="list-style-type: none"> <li>• develop an analytical approach</li> <li>• taking a proactive approach</li> <li>• developing strategies to solve problems</li> <li>• being open minded</li> <li>• coordinate engineering teams</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

## 7. Expected Learning Outcomes

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge | <p>The student has knowledge of:</p> <ul style="list-style-type: none"> <li>• apply ICT systems theory</li> <li>• create data sets</li> <li>• define technical requirements</li> <li>• design process</li> <li>• develop creative ideas</li> <li>• deliver visual presentation of data</li> <li>• creatively use digital technologies</li> <li>• use data processing techniques</li> <li>• manage system testing</li> <li>• assess ICT knowledge</li> <li>• manage database</li> <li>• implement ICT security policies</li> <li>• use an application-specific interface</li> <li>• utilise machine learning</li> <li>• conduct scholarly research</li> </ul> |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Skills                        | <p>The student is able to:</p> <ul style="list-style-type: none"> <li>• manage ICT data architecture</li> <li>• manage data</li> <li>• manage quantitative data</li> <li>• manage research data</li> <li>• process data</li> <li>• store digital data and systems</li> <li>• use data processing techniques</li> <li>• use databases</li> <li>• create data models</li> <li>• analyse decentralised applications</li> <li>• debug software</li> <li>• interpret technical requirements</li> <li>• use software libraries</li> <li>• utilise computer-aided software engineering (CASE) tools</li> <li>• adapt to changes in technological development plans</li> </ul> |
| Responsibilities and autonomy | <p>The student has the ability to work independently in order to:</p> <ul style="list-style-type: none"> <li>• develop an analytical approach</li> <li>• take a proactive approach</li> <li>• develop strategies to solve problems</li> <li>• be open minded</li> <li>• coordinate engineering teams</li> </ul>                                                                                                                                                                                                                                                                                                                                                        |

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

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.1 General objective   | Preparing students and providing up-to-date information in the field of wide area networks, sensor networks, network security, Internet architecture. It aims to increase the capacity of analysis within the specific field, as well as to develop skills for design.                                                                                                                                                                                                                                                                                                                      |
| 8.2 Specific objectives | <p>Acquiring new theoretical knowledge specific to modern computer networks and security in computer networks</p> <p>New skills and abilities acquired:</p> <ul style="list-style-type: none"> <li>- Performance evaluation in high-speed networks, routing techniques in WANs, basic elements of network security (vulnerabilities, attacks, encryption, authentication), sensor network design elements</li> <li>- Configuration of MPLS routers, configuration of security equipment (virtual networks, firewall), elaboration of synthesis materials for specific subdomains</li> </ul> |

#### 9. Contents

| 9.1 Lectures                                                                                                                                                                                                                                                                                                   | Hours | Teaching methods                                                                                                                                                                                                                                    | Notes |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| MPLS (MultiProtocol Label Switching): MPLS concept; MPLS terminology (labels, equivalent classes, nodes in the MPLS network domain, switched paths); assigning, distributing and storing labels; protocols for signaling and distribution of labels; operations in the field of MPLS network.                  | 4     | <p>Oral exposures.</p> <p>Presentation using slides, discussions (Q&amp;A), consultations.</p> <p>The use of multimedia means, interactive teaching style, offering programs for self-testing, attraction in research contracts, consultations.</p> |       |
| MPLS-VPN (virtual private networks based on MPLS): models of virtual private networks (overlay, peer); MPLS-VPN terminology (provider network, client network, routers, site, VRF table); MPLS-VPN model; packet transmission mechanism; the steps of defining/configuring a virtual private MPLS network.     | 4     |                                                                                                                                                                                                                                                     |       |
| InfiniBand (Infinite Bandwidth): tcp/ip stack limitations in a data center; definition of the InfiniBand concept; architecture and components: links, channel adapters, switches, routers, management components; communication and I/O operations: queues, communication semantics, remote DMS; communication |       |                                                                                                                                                                                                                                                     |       |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |              |                                                                                                                                                                                                                                 |              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| architecture; keys, virtual memory addressing, shared domains; virtual lines, QoS, multicast; management; comparison with other technologies (interfaces: PCI, PCI-X, interconnection technologies: Myrinet, Quadrics).                                                                                                                                                                                                                                                                                                               | 4            |                                                                                                                                                                                                                                 |              |
| Architectures for implementing elements of Quality of Service                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2            |                                                                                                                                                                                                                                 |              |
| Architectures for implementing elements of security in computer networks; security fundamentals.                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4            |                                                                                                                                                                                                                                 |              |
| Gear for implementing security                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2            |                                                                                                                                                                                                                                 |              |
| Private key encryption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2            |                                                                                                                                                                                                                                 |              |
| Public key encryption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 2            |                                                                                                                                                                                                                                 |              |
| Authentication                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2            |                                                                                                                                                                                                                                 |              |
| Specificity of security in wireless sensor networks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2            |                                                                                                                                                                                                                                 |              |
| Bibliography: <ul style="list-style-type: none"><li>• V.Dadarlat, E.Cebuc – Retele Locale de Calculatoare-de la cablare la interconectare, Ed. Albastra, 2006</li><li>• W. Stallings – Data and Computer Communications, Prentice Hall, 2007</li><li>• W. Stallings – Cryptography and Network Security, Prentice Hall, 2007</li><li>• Peter Tomsu, Gerhard Wieser - MPLS Based VPNS: Designing Advanced Virtual Networks, Prentice Hall, 2001</li><li>• Tom Shanley- InfiniBand Network Architecture, Addison-Wesley, 2002</li></ul> |              |                                                                                                                                                                                                                                 |              |
| <b>9.2 Applications - Seminars/Laboratory/Project</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Hours</b> | <b>Teaching methods</b>                                                                                                                                                                                                         | <b>Notes</b> |
| MPLS signaling protocols: comparative analysis                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1            | Oral exposure.<br>Presentation using slides, discussions (Q&A), consultations.<br>The use of multimedia means, interactive teaching style, offering programs for self-testing, attraction in research contracts, consultations. |              |
| MPLS based virtual private networks: design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1            |                                                                                                                                                                                                                                 |              |
| QoS implementation: test cases                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1            |                                                                                                                                                                                                                                 |              |
| Algorithms for encryption based on private key                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 2            |                                                                                                                                                                                                                                 |              |
| Standards for public key encryption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2            |                                                                                                                                                                                                                                 |              |
| Bibliography: <ul style="list-style-type: none"><li>• V.Dadarlat, E.Cebuc – Retele Locale de Calculatoare-de la cablare la interconectare, Ed. Albastra, 2006</li><li>• W. Stallings – Data and Computer Communications, Prentice Hall, 2007</li><li>• W. Stallings – Cryptography and Network Security, Prentice Hall, 2007</li><li>• Peter Tomsu, Gerhard Wieser - MPLS Based VPNS: Designing Advanced Virtual Networks, Prentice Hall, 2001</li><li>• Tom Shanley- InfiniBand Network Architecture, Addison-Wesley, 2002</li></ul> |              |                                                                                                                                                                                                                                 |              |

*\*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

The content of the discipline was discussed with teachers in the field from our country (Politehnica Bucharest and Timisoara), but also abroad (France, Ireland, Finland), being evaluated and endorsed by ARACIS.

## 10. Evaluation

| Activity type | Assessment criteria                                                                                            | Assessment methods                                                                                                                                                       | Weight in the final grade |
|---------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| Course        | Ability to analyze specific problems<br>The power of synthesis of information related to a specific subdomain. | The exam consists of checking theoretical knowledge (questions) in writing (2 hours), plus the evaluation of a report (synthesis material) based on topics in the field. | 70%                       |

|                                                                                                                                                                                        |                                     |                                      |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------------------------------|-----|
| Seminar                                                                                                                                                                                | Ability to solve specific problems. | Colloquium based on written answers. | 30% |
| Laboratory                                                                                                                                                                             | N/A                                 |                                      |     |
| Project                                                                                                                                                                                | N/A                                 |                                      |     |
| Minimum standard of performance:<br>Minimum standard of performance: Solving design problems, elaborating synthesis studies for specific subdomains with a minimum of personal vision. |                                     |                                      |     |

|                                   |              |                                     |           |
|-----------------------------------|--------------|-------------------------------------|-----------|
| Date of filling in:<br>29.04.2026 | Responsible  | Title First name Last name          | Signature |
|                                   | Course       | Prof.dr.eng. Vasile Teodor DĂDÂRLAT |           |
|                                   | Applications | Prof.dr.eng. Vasile Teodor DĂDÂRLAT |           |
|                                   |              |                                     |           |

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