**Universitatea Naţională de Ştiinţă şi Tehnologie Politehnica Bucureşti**
**Facultatea de Electronică, Telecomunicaţii şi**
**Tehnologia Informaţiei**

# COURSE DESCRIPTION

## 1. Program identification information

| | |
|---|---|
| 1.1 Higher education institution | **National University of Science and Technology Politehnica Bucharest** |
| 1.2 Faculty | **Electronics, Telecommunications and Information Technology** |
| 1.3 Department | **Telecommunications** |
| 1.4 Domain of studies | Electronic Engineering, Telecommunications and Information Technology |
| 1.5 Cycle of studies | Bachelor/Undergraduate |
| 1.6 Programme of studies | Technologies and Telecommunications Systems |

## 2. Date despre disciplină

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2.1 Course name (ro)<br>(en) | | | | Introducere în sisteme de operare şi virtualizare<br>Basics of Operating Systems and Virtualization | | | |
| 2.2 Course Lecturer | | | | Prof. Dr. Marius-Constantin Vochin | | | |
| 2.3 Instructor for practical activities | | | | Prof. Dr. Marius-Constantin Vochin | | | |
| 2.4 Year of studies | 3 | 2.5 Semester | 2 | 2.6. Evaluation type | V | 2.7 Course regime | Op |
| 2.8 Course type | | S | 2.9 Course code | 04.S.06.A.228 | | 2.10 Tipul de notare | Nota |

## 3. Total estimated time (hours per semester for academic activities)

| | | | | | |
|---|---|---|---|---|---|
| 3.1 Number of hours per week | 3 | Out of which: 3.2 course | 2 | 3.3 seminary/laboratory | 1 |
| 3.4 Total hours in the curricula | 42 | Out of which: 3.5 course | 28 | 3.6 seminary/laboratory | 14 |
| Distribution of time: | | | | | hours |
| Study according to the manual, course support, bibliography and hand notes<br>Supplemental documentation (library, electronic access resources, in the field, etc)<br>Preparation for practical activities, homework, essays, portfolios, etc. | | | | | -2 |
| Tutoring | | | | | 4 |
| Examinations | | | | | 6 |
| Other activities (if any): | | | | | 0 |

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| 3.7 Total hours of individual study | 8.00 |
| 3.8 Total hours per semester | 50 |
| 3.9 Number of ECTS credit points | 2 |

## 4. Prerequisites (if applicable) (where applicable)

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| 4.1 Curriculum | Not applicable |
| 4.2 Results of learning | Basic knowledge of networking and operating systems |

## 5. Necessary conditions for the optimal development of teaching activities (where applicable)

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| 5.1 Course | Lecture room with projector |

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| 5.2 Seminary/ Laboratory/Project | Laboratory room with virtual machines and access to a virtualization server with both Windows and Linux machines |

**6. General objective** *(Reffering to the teachers' intentions for students and to what the students will be thought during the course. It offers an idea on the position of course in the scientific domain, as well as the role it has for the study programme. The course topics, the justification of including the course in the currcula of the study programme, etc. will be described in a general manner)*

Presentation of basic notions regarding the organization and functions of operating systems, examples of existing operating systems and highlighting the architecture and management attributes for the systems of Windows and Linux operation. Students will study general virtual machine architectures and understand each
component. The technologies that make up a virtual architecture composed of servers will be discussed at the basic level, virtual workstations, virtual networks, etc. It will describe the main issues that arise in the release
and maintenance of a virtual infrastructure. The main protocols for communication between
server and client workstations such as Remote Desktop, PCoIP and others. Students will analyze the solutions
of virtualization offered by VMWare and Citrix compared, along with all technologies and components related, aiming to implement the knowledge by launching and operating their own virtual infrastructures servers or workstations.

**7. Competences** *(Proven capacity to use knowledge, aptitudes and personal, social and/or methodological abilities in work or study situations and for personal and proffesional growth. They refflect the empolyers requirements.)*

| | |
|---|---|
| **Specific Competences** | C1. Advanced usage of Windows and Linux operating systems<br>C2. Command line configuration and management of operating systems<br>C3. Complete installation of any operating system as a virtual machine<br>C4. Apprehension of operating system virtualization and practical implementation of a virtual architecture on a VMware platform or a Citrix platform |
| **Transversal (General) Competences** | Works in a team and communicates effectively, coordinating efforts with others to solve problem situations of medium complexity.<br>Autonomy and critical thinking: the ability to think in scientific terms, search and analyze data independently, and draw and present conclusions / identify solutions.<br>Ability to analyze and synthesize: presents the acquired knowledge in a synthetic way, as a result of a process of systematic analysis.<br>Respect the principles of academic ethics: correctly cite the bibliographic sources used in the documentation activity.<br>Puts elements of emotional intelligence into practice in the appropriate social-emotional management of real-life/academic/professional situations, demonstrating self-control and objectivity in decision-making or stressful situations. |

**8. Learning outcomes** *(Synthetic descriptions for what a student will be capable of doing or showing at the completion of a course. The learning outcomes reflect the student's acomplishments and to a lesser extent the teachers' intentions. The learning outcomes inform the students of what is expected from them with respect to performance and to obtain the desired grades and ECTS points. They are defined in concise terms, using verbs similar to the examples below and indicate what will be required for evaluation. The learning outcomes will be formulated so that the correlation with the competences defined in section 7 is highlighted.)*

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|---|---|
| **Knowledge** | *The result of knowledge aquisition through learning. The knowledge represents the totality of facts, priciples, theories and practices for a given work or study field. They can be theoretical and/or factual.*<br>• Students will study the general virtual machine architectures and understand each component.<br>• The technologies that make up a virtual architecture composed of virtual servers, virtual workstations, virtual networks and so on will be discussed at a basic level.<br>• The main protocols for communication between the server and client workstations such as Remote Desktop, PCoIP, and others will be presented.<br>• Students will analyse the virtualization solutions offered by VMware and Citrix, along with all related technologies and components, aiming to offer knowledge for deploying and operating their own virtual server or workstation infrastructures. |
| **Skills** | *The capacity to apply the knowledge and use the know-how for completing tasks and solving problems. The skills are described as being cognitive (requiring the use of logical, intuitive and creative thinking) or practical (implying manual dexterity and the use of methods, materials, tools and intrumentation).*<br>• Ability to operate Linux and Windows operating systems<br>• Ability to allocate resources and monitor hardware resources in Windows and Linux<br>• Ability to use command line in both Windows and Linux to operate networking and file management<br>• Ability to develop simple automation scripts in Linux<br>• Ability to deploy virtual machines over a virtual infrastructure<br>• Ability to manage and modify a virtual desktop infrastructure with VMware and Citrix<br>• Ability to connect to remote machines using Remote Desktop, VNC and SSH. |
| **Responsability and autonomy** | *The student's capacity to autonomously and responsably apply their knowledge and skills.*<br>• Select appropriate bibliographic sources and analyze them.<br>• Respects the principles of academic ethics, correctly citing the bibliographic sources used.<br>• Demonstrates receptivity to new learning contexts.<br>• Shows collaboration with other colleagues and teachers in carrying out teaching activities<br>• Demonstrates autonomy in organizing the learning situation / context or problem situation to be solved<br>• Demonstrates social responsibility through active involvement in student social life / involvement in events in the academic community<br>• Promotes / contributes through new solutions, related to the specialized field in order to improve the quality of social life.<br>• Awareness of the value of his contribution in the field of engineering to the identification of viable / sustainable solutions to solve problems in social and economic life (social responsibility).<br>• Applies principles of professional ethics / deontology in the analysis of the technological impact of the solutions proposed in the specialized field on the environment.<br>• Analyzes and capitalizes on business opportunities / entrepreneurial development in the specialized field.<br>• Demonstrates skills in managing real-life situations (time management, collaboration vs. conflict). |

**9. Teaching techniques** *(Student centric techniques will be considered. The means for students to participate in defining their own study path, the identification of eventual fallbacks and the remedial measures that will be adopted in those cases will be described.)*

Starting from the analysis of students' learning characteristics and their specific needs, the teaching process will explore both expository (lecture, presentation) and conversational-interactive teaching methods, based on discovery learning models facilitated by direct exploration. and indirect reality (experiment, demonstration, modeling), but also on action-based methods, such as exercise, practical activities and problem solving.
Lectures will be used in the teaching activity, based on Power Point presentations or various videos that will be made available to students. Each course will begin with a recap of the chapters already covered, with an emphasis on the concepts covered in the last course.
Presentations use images and diagrams so that the information presented is easy to understand and assimilate.
This discipline covers information and practical activities designed to support students in their efforts to learn and develop optimal collaborative and communicative relationships in a climate conducive to learning through discovery.
It will be considered the exercise of the skills of active listening and assertive communication, as well as the mechanisms of building feedback, as ways of behavioural regulation in various situations and adapting the pedagogical approach to the learning needs of students.
The ability to work in a team to solve different learning tasks will be practiced.

**10. Contents**

| **COURSE** | | |
|---|---|---|
| **Chapter** | **Content** | **No. hours** |
| 1 | Introduction to operating systems<br>Structure, concepts and functions of an OS. | 4 |
| 2 | Hardware analysis of a computing system<br>Basic components and peripheral interconnection.<br>Boot and recovery process. | 4 |
| 3 | File system<br>Partition types, file system fragmentation, and file system errors.<br>Administrative commands for working with files.<br>Introduction to shell scripting. | 6 |
| 4 | Introduction to Virtualization Systems.<br>Components required to implement virtualization.<br>WMware and Citrix virtualization solutions - general description.<br>Introduction to Cloud Computing.<br>Server consolidation | 2 |
| 5 | WMware virtualization solution.<br>Data Center Virtualization - Description and Challenges.<br>VMware Infrastructure. VMware vSphere. Storage in vSphere.<br>Network in vSphere.<br>Solving challenges with vSphere | 4 |
| 6 | Citrix virtualization solution.<br>Introduction to Citrix Technologies.<br>XenServer - description and functionality.<br>XenOchestra - Automatic Infrastructure Management | 4 |

| | | |
|---|---|---|
| 7 | Clients for virtual workstation infrastructures.<br>Thin Client - description and functionality.<br>Remote Connection Protocols - PCoIP and Remote Desktop.<br>Case study – RaspberryPi thin client | 4 |
| | **Total:** | 28 |

**Bibliography:**

1. Vochin Marius, Popa Victor, ”Introducere în sisteme de operare şi virtualizare”, electronic support for course, https://curs.upb.ro/2021/course/view.php?id=9706.
2. Introducere în sisteme de operare, Razvan Deaconescu, 2009, ISBN 6065213861, 978606521386
3. Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos
4. Greg Schulz, ”Cloud and Virtual Data Storage Networking”, Editura CRC Press, 2011
5. Forbes Guthrie, Scott Lowe, ” VMware VSphere Design, 2nd Edition”, Editura Sybex, 2011
6. Duncan Epping, ”VMware vSphere 5.1 Clustering Deepdive”, 2012
7. https://mylearn.vmware.com/mgrreg/index.cfm
8. https://discussions.citrix.com

**LABORATORY**

| Crt. no. | Content | No. hours |
|---|---|---|
| 1 | Introduction to the Linux command line | 2 |
| 2 | The Linux file system | 2 |
| 3 | Process management in Linux | 2 |
| 4 | Type 2 hypervisors | 2 |
| 5 | VMware Solution. PCoIP Client | 2 |
| 6 | Citrix Solution. Client Remote Desktop | 2 |
| 7 | Laboratory assessment | 2 |
| | **Total:** | 14 |

**Bibliography:**

- Vochin Marius, Popa Victor, ”Introducere în sisteme de operare şi virtualizare”, electronic support for course, https://curs.upb.ro/2021/course/view.php?id=9706.
- Introducere în sisteme de operare, Razvan Deaconescu, 2009, ISBN 6065213861, 978606521386
- Modern Operating Systems, Andrew S. Tanenbaum, Herbert Bos
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- Forbes Guthrie, Scott Lowe, ” VMware VSphere Design, 2nd Edition”, Editura Sybex, 2011
- Duncan Epping, ”VMware vSphere 5.1 Clustering Deepdive”, 2012
- https://mylearn.vmware.com/mgrreg/index.cfm
- https://discussions.citrix.com/

**11. Evaluation**

| Activity type | 11.1 Evaluation criteria | 11.2 Evaluation methods | 11.3 Percentage of final grade |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | - knowledge of the fundamental concepts related to the operation of an operating system<br>- classification of operating systems | - a test at the end of the semester | 30% |
| 11.4 Course | - knowledge of fundamental virtualization technologies using either VMware or Citrix<br>- knowing the basic challenges in launching virtual infrastructures and how to solve them<br>- knowing the main remote connection technologies | - a test at the end of the semester | 30% |
| 11.5 Seminary/laboratory/project | - performing tasks using the command line<br>- process automation using shell scripts<br>- configuring a virtual machine on a Type 2 Hypervisor<br>- installing and configuring a virtual infrastructure using VMware and Citrix type 1 hypervisors<br>- configure a set of clients using the PCoIP and Remote Desktop protocols | The final laboratory test is comprised of a practical component and a theoretical component. The practical component is verified by assessing the ability to configure a virtual infrastructure as well as managing an operating system. | 40% |
| 11.6 Passing conditions | | | |
| Exemplu:<br>Obținerea a 50% din punctajul total.<br>Obținerea a 50% din punctajul aferent activității pe parcursul semestrului.<br>**Atenție la Regulamentul de studii aplicabil, se pot include aici referințe în acest sens!** | | | |

**12. Corroborate the content of the course with the expectations of representatives of employers and representative professional associations in the field of the program, as well as with the current state of knowledge in the scientific field approached and practices in higher education institutions in the European Higher Education Area (EHEA)**

· This course features current or emerging technologies for virtual infrastructures, with all their components, as well as knowledge for installation and management. The course opens the way to the concept of Cloud Computing that represents the future of online services.

· Through the activities carried out, the students develop skills to offer solutions to some problems and to propose ideas to improve the situation of existence in the field of Cloud computing, the virtual machines industry.

· In the development of the content of the discipline, knowledge / aspects / phenomena described by the specialized literature / own researches published / presented, etc. were taken into account.

The activities at this course aim to develop the graduate's skills in managing practical situations that he may face in real life in order to increase his contribution to improving the socio-economic environment.

| Date | Course lecturer | Instructor(s) for practical activities |
|---|---|---|
| 21.09.2026 | Prof. Dr. Marius-Constantin Vochin | Prof. Dr. Marius-Constantin Vochin |

| Date of department approval | Head of department |
|---|---|
| 22.09.2026 | Conf. Dr. Serban Georgica Obreja |

| Date of approval in the Faculty Council | Dean |
|---|---|
| 22.09.2026 | Prof. Dr. Mihnea Udrea |