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	Masters
1.6 Programme of studies	Services and Network Management

2. Date despre disciplină

2.1 Course name (ro) (en)				Cloud şi inteligenţă artificială aplicată Cloud and Applied Artificial Intelligence			
2.2 Course Lecturer				Lect. PhD Cornelia Ionela BĂDOI			
2.3 Instructor for practical activities				Lect. PhD Cornelia Ionela BĂDOI			
2.4 Year of studies	1	2.5 Semester	2	2.6. Evaluation type	E	2.7 Course regime	Ob
2.8 Course type		S	2.9 Course code	3		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 Supplemental documentation (library, electronic access resources, in the field, etc) Preparation for practical activities, homework, essays, portfolios, etc.					52
Tutoring					2
Examinations					4
Other activities (if any):					0

3.7 Total hours of individual study	58.00
3.8 Total hours per semester	100
3.9 Number of ECTS credit points	4

4. Prerequisites (if applicable) (where applicable)

4.1 Curriculum	Completion of the following disciplines: Cloud and Containerization Services, Artificial Intelligence, Networks and Services.
4.2 Results of learning	Fundamental knowledge in artificial intelligence, machine learning, networking and communication protocols, as well as skills in programming (Python) and IT services.

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

5.1 Course	According to the regulations of university studies at NUSTPB. The presentations are delivered using modern display technologies, such as a video projector or an LCD screen.
5.2 Seminary/ Laboratory/Project	The laboratory is conducted on an infrastructure comprising computers or laptops with Internet access, running either Windows or Linux operating systems. For the use of serverless services (e.g., AI, GenAI, data stream processing or integration), Linux is recommended due to its broader compatibility with specific tools; however, its use is not mandatory. The integration of virtual networks may involve both serverless and non-serverless solutions, depending on the chosen architecture. The following prerequisites are required: • a modern web browser (Chrome, Edge, Firefox, Safari), as nearly all Azure/AWS cloud services and most laboratory activities are accessed through the browser, without the need for additional installations on the local machine; • an SSH client (PuTTY for Windows, integrated terminal in Linux) for connecting to Linux virtual machines deployed in Azure or AWS; • a code editor (e.g., Visual Studio Code) for writing and editing code prior to deployment in the cloud; • a command-line interface (CLI): Azure CLI for resource management from the terminal in Azure, and AWS CLI for management, scripting, and automation in AWS. The laboratory will be carried out using either the Azure or AWS platforms, within the “Free Tier” framework, which ensures free access to the core cloud services required for the completion of practical activities.

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)*

The main objective of the course “Cloud and Applied Artificial Intelligence” (CAAI) is to familiarize students with current principles, models, and technologies in the integration of cloud computing (CC) and artificial intelligence (AI) services, covering both theoretical concepts and practical applications, within the context of digital transformation and innovation in modern computing infrastructures.

The course is intended for information technology students and explores the convergence of cloud platforms and applied AI, including essential and advanced topics related to key cloud providers (Microsoft Azure, Amazon Web Services, Google Cloud Platform), Edge Cloud infrastructures, AI service integration and orchestration, cloud network management and modeling, generative AI (GenAI) usage, and emerging trends, with emphasis on hands-on applications, security, ethics, and sustainability.

Throughout its content, the course aims to develop strong knowledge and skills that enable students to design, implement, and assess advanced cloud and AI solutions, preparing them for careers in the digital industry and for research and innovation in smart, autonomous cloud ecosystems.

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	• Demonstrates strong expertise in the planning, development, and management of modern cloud architectures and services, with the intelligent integration of AI technologies, approached from both a theoretical and, most importantly, an applied perspective. • Integrates and connects knowledge on service models, traditional cloud infrastructure and edge cloud, containerized systems, and large-scale resource orchestration, with an emphasis on employing AI for optimization, advanced analytics, and innovation. • Applies in practice the standardized concepts and tools of CC and AI for the configuration, deployment, monitoring, and evaluation of complex solutions, efficiently managing resources and end-to-end data flows, including through the use of GenAI and the incorporation of emerging trends within the “Cloud AI” ecosystem. • Analyzes, argues, and communicates coherently problems, solutions, and innovations in the fields of cloud and applied AI, using a scientific vocabulary in both Romanian and English. • Employs modern methods for the assessment, diagnosis, and optimization of intelligent cloud systems, adopting best practices in technology, security, ethics, and sustainability, in the broader context of emerging technologies.
Transversal (General) Competences	• Works effectively in teams and communicates with clarity, coordinating efforts with others to address and resolve medium-complexity problems. • Demonstrates autonomy and critical thinking, with the ability to reason in scientific terms, to independently search for and analyze data, to formulate and present conclusions, and to identify appropriate solutions. • Exhibits capacity for analysis and synthesis by presenting acquired knowledge in a concise and structured manner, as the outcome of systematic inquiry. • Adheres to the principles of academic ethics, citing bibliographic sources accurately and responsibly in research and documentation activities. • Applies elements of emotional intelligence to appropriately manage socio-emotional situations in academic, professional, and real-life contexts, showing self-control, balance, and objectivity in decision-making and in handling stress.

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.)*

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.* The evolution of cloud infrastructures, combined with the rapid progress of AI technologies, has brought fundamental transformations in the design, deployment, and operation of applications and digital services. In particular, the high performance computing capabilities, the availability of both public and private cloud platforms, as well as breakthroughs in AI (including GenAI), now enable the development of fully virtualized, scalable ecosystems capable of dynamically adapting to the demands of modern organizations. Leading cloud platforms such as Microsoft Azure, Amazon Web Services (AWS), and Google Cloud Platform (GCP) have introduced specialized “Cloud AI” services, which integrate computing resources, data analytics tools, and advanced machine learning models. These services support a wide spectrum of applications, ranging from industrial and financial processes to education, healthcare, public administration, and scientific research. Moreover, Edge Cloud infrastructures offer the advantage of processing data closer to the source, thereby reducing latency and facilitating the adoption of AI in mission critical scenarios. The course highlights the convergence between Cloud and AI, drawing on theoretical components while placing particular emphasis on hands on applications. Students will acquire knowledge of the fundamental concepts and deployment models of cloud computing, explore the end to end integration of AI services within cloud infrastructures, analyze serverless architectures and intelligent automation scenarios, and develop an understanding of how AI can contribute to the design, configuration, and security of virtual networks. Special focus is placed on GenAI, which is redefining both content creation and digital processes, as well as on emerging trends such as multimodal AI, agentic ecosystems, energy efficiency, and the ethical dimensions of AI adoption in the cloud. The training is structured around the following key directions: • Fundamentals of CC: concepts, service models, and deployment. • Reference cloud platforms (Azure, AWS, GCP) and Edge Cloud infrastructures. • AI services in the cloud: recognition, analysis, processing, API integration, and cognitive services. • End to end AI integration and the development of intelligent pipelines. • Utilizing AI for the design and management of virtual networks. • Applying GenAI concepts within cloud platforms. • Emerging trends and directions in “Cloud AI”: multimodality, autonomy, sustainability, ethics, and security. The course adopts an applied orientation, with laboratory sessions focused on managing virtual infrastructures, implementing serverless architectures, integrating AI services into cloud applications, and developing solutions that leverage GenAI and the automated orchestration of data flows.

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).* • Selects and processes relevant data by employing concepts and models of CC and AI in applied contexts. • Evaluates, compares, and applies the functionalities of major cloud platforms (Azure, AWS, GCP), adapting to the specifics of each provider and analyzing solutions that are appropriate for diverse scenarios. • Designs and implements end-to-end workflows that integrate AI services into cloud infrastructures, ensuring scalability, efficiency, and security for automated, industrial, or commercial processes. • Applies specialized techniques and tools for the management, simulation, and optimization of AI-assisted cloud networks, including traffic analysis and automated vulnerability detection. • Explores and implements GenAI-based solutions in the cloud, identifying contexts of use, advantages, challenges, and best practices for innovation and automation. • Justifies the selection of AI technologies and services in cloud architectures by developing case studies and project proposals oriented towards efficiency, ethics, and responsibility. • Collaborates effectively within a team to implement AI-driven cloud solutions, capitalizing on interdisciplinary communication skills and analytical thinking. • Prepares relevant scientific reports and presentations, accurately interpreting experimental results and formulating data-driven conclusions. • Monitors emerging trends in the field of Cloud AI, evaluating how innovations, regulations, sustainability, and ethical considerations shape the development of intelligent services.
Responsability and autonomy	*The student's capacity to autonomously and responsably apply their knowledge and skills.* • Identifies and selects relevant bibliographic sources in the fields of cloud and AI, engaging in critical content analysis. • Adheres to academic and professional ethical principles by properly citing sources and upholding intellectual integrity in all activities. • Demonstrates openness to emerging contexts and technologies, using up-to-date learning resources in the domains of cloud and AI. • Collaborates effectively with peers and faculty to achieve educational and interdisciplinary research objectives. • Shows autonomy in managing learning processes and in identifying and addressing problem situations specific to cloud and AI technologies. • Displays social responsibility by actively participating in student projects, academic events, and initiatives that foster technological innovation with positive impact. • Proposes and develops innovative solutions in cloud and AI aimed at enhancing social and economic quality of life. • Recognizes the value of both individual and team contributions in addressing real-world challenges, assuming the role of a responsible innovator in engineering and technology. • Applies ethical and professional standards to assess the technological impact and sustainability of proposed solutions on society and the environment. • Analyzes and leverages opportunities for entrepreneurial development and digital innovation in cloud and AI. • Demonstrates real-world management skills by effectively handling time, collaboration, and potential conflicts in academic or professional activities.

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.)*

The didactic approach of the CAAI course is grounded in a rigorous analysis of students' learning particularities and individual needs, aiming to diversify teaching strategies in order to facilitate the development of digital competences in an accessible, inclusive way, while adapting to technological progress.

The course content includes both up-to-date information and practical activities that stimulate active learning, foster collaborative and communicative relationships, and encourage a climate open to innovation. It targets active listening, assertive communication, constructive feedback, and teamwork skills, all serving as methods of behavioral regulation and adaptation of the educational process to each student's learning rhythm and style, with a special focus on the CC and AI challenges.

Teaching relies on a wide range of methods:

- expository methods (lecture and presentation);
- interactive and conversational methods;
- discovery-based learning methods, facilitating both direct and indirect exploration of the digital environment through experimentation, demonstrations, and the modeling of cloud and AI scenarios;
- action-based strategies, including practical activities and solving real-world problems in the field of advanced technologies.

To enhance accessibility, flexibility, and relevance, the curriculum incorporates modern e-learning platforms, in particular Moodle, which supports synchronous teaching (videoconferences, live discussions) and asynchronous access (on-demand materials), resource and assignment management, online assessments, as well as tools for collaboration and personalized feedback.

Open Educational Resources (OER) are also integrated, provided free of charge by Microsoft Learn, AWS Training and Certification, and Google Cloud Training, complemented with materials from universities and global platforms, such as courses, virtual labs, and up-to-date video tutorials.

The blended learning format, combining in-class teaching with online Moodle sessions and video meetings, enables participation for all students, including those unable to attend physically, while offering flexibility for independent pacing of study and task completion.

Each course chapter is enriched with free, interactive, and relevant open-access online courses (MOOCs): introductory cloud computing courses, modules for the main platforms (Azure, AWS, Google Cloud), resources on edge cloud infrastructures, cloud-AI convergence, full AI-service integration, AI for cloud networks, elements of generative AI, as well as perspectives on emerging trends (ethics, regulation, security, green cloud, agentic and multimodal AI).

Additional innovative teaching methods, requiring no extra costs, are also employed: collaborative micro-projects using free platforms (Google Docs and/or GitHub for source-code development, Slack for team communication), peer-teaching sessions where students explain concepts to one another, reinforcing understanding, thematic mini-hackathons with free API and cloud service trials (Azure for Students, Google Cloud Free Tier), interactive quizzes and recaps via free apps (Kahoot!, Socrative), and technological

storytelling activities, where students structure and present solutions visually with free graphic tools.

Through this methodological interdisciplinarity and use of current digital resources, the CIAA course provides a modern, flexible, and inclusive learning framework that promotes relevant competences, authentic collaboration, and ongoing adaptation to the dynamics of cloud and artificial intelligence, offering thus each student the opportunity to maximize their potential according to contemporary performance standards.

10. Contents

COURSE		
Chapter	**Content**	**No. hours**
1	Introduction to cloud computing (CC) 1.1. Basic concepts and definitions 1.2. Deployment models 1.3. Service models 1.4. Differences and benefits compared to traditional on-premises infrastructure	2
2	Cloud reference platforms 2.1. Architectural structures and functionalities 2.2. Microsoft Azure 2.3. Amazon Web Services (AWS) 2.4. Google Cloud Platform (GCP) 2.5. Comparative analysis: Azure, AWS and GCP	4
3	Edge Cloud (EC) infrastructures 3.1. EC definition and principles 3.2. EC architecture 3.3. Comparing EC with traditional cloud models 3.4. Industrial applications and challenges	2
4	Convergence between cloud and artificial intelligence (AI) 4.1. Theoretical and applied approaches in AI 4.2. The notion of "Cloud AI" 4.3. AI services in cloud 4.3.1. Concepts, advantages and challenges 4.3.2. Azure AI services 4.3.3. AWS AI services 4.3.4. GCP AI services	4
5	Integration of AI services in end-to-end cloud processes 5.1. Defining and modeling end-to-end data flows 5.2. Orchestration of AI services in cloud architectures 5.3. Scalability, cost optimization and best practices in cloud 5.4. Case studies and end-to-end applications	4
6	AI services for modeling and configuring networks in cloud 6.1. Fundamental concepts and AI-assisted virtual network architectures 6.2. Intelligent tools and services for design/simulation in cloud (AWS VPC, Azure Virtual Network, Google Cloud VPC) 6.3. AI for traffic analysis, optimization and vulnerability detection 6.4. Integration of AI in cloud network management	4

7	Generative artificial intelligence (GenAI) in cloud 7.1. Definition of GenAI and fundamental principles 7.2. GenAI structures and services 7.3. Practical applications, use cases and industries 7.4. Challenges and recommended practices	4
8	Emerging trends, research directions and innovation in "Cloud AI" 8.1. Agentic AI models and autonomous ecosystems 8.2. Multimodal AI and infrastructure augmentation 8.3. "Green" cloud and energy-efficient AI 8.4. Regulation, ethics and security	4
	Total:	28

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LABORATORY		
Crt. no.	**Content**	**No. hours**

1	Administration of virtual infrastructures in cloud: design and operation of virtual machines (VM)	2
2	Serverless architectures and intelligent automation through cloud functions	2
3	Integration of cognitive services and AI APIs in cloud applications	2
4	Modeling and management of intelligent virtual networks in cloud ecosystems	2
5	Orchestration and automated analysis of end-to-end data flows with intelligent cloud tools	2
6	GenAI applications in cloud platforms	2
7	Final laboratory colloquium – project presentation and evaluation	2
	Total:	14

Bibliography:

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11. Evaluation

Activity type	11.1 Evaluation criteria	11.2 Evaluation methods	11.3 Percentage of final grade
11.4 Course	Final assessment: • knowledge of fundamental theoretical concepts in the field of cloud and applied AI; • application of theory to identify, analyze, and solve specific problems of designing and integrating cloud and AI solutions; • comparison, critical evaluation, and argumentation of the advantages of different technologies, platforms, and methods used in practice in the cloud and AI field.	Written test	50%
11.5 Seminary/laboratory/project	Practical application	Development of a practical application based on the concepts acquired during the laboratory (final laboratory project).	50%
11.6 Passing conditions			
• Fulfilling the obligations characteristic of laboratory activities (participating in the planned works). • Obtaining 50% of the total score.			

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)

The curriculum of the discipline is aligned with international educational standards and the innovative initiatives promoted by the National University of Science and Technology Politehnica Bucharest, providing a rigorous academic and professionally relevant framework.
The course offers students an integrated perspective on current digital ecosystems, wherein cloud, AI, and new networking paradigms converge to support global digital transformation.
By delving into the proposed topics, students develop solid preparation for integration into competitive

fields such as hybrid and edge cloud infrastructures, AI applied to industrial processes, as well as emerging technologies dedicated to optimizing IT systems' performance and security. Furthermore, the discipline addresses labor market requirements by preparing professionals capable of managing complex infrastructures, developing innovative and sustainable solutions, and actively contributing to the digital evolution of the socio-economic environment.
At the same time, it aims to foster critical skills in analyzing and solving complex situations and in adopting responsible emerging technologies, thereby supporting the consolidation of future specialists' roles in shaping the next generation of intelligent digital applications and services.

Date	Course lecturer	Instructor(s) for practical activities
21.09.2026	Lect. PhD Cornelia Ionela BĂDOI	Lect. PhD Cornelia Ionela BĂDOI

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