

SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and Information Technology
1.3 Department	Communications
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Master of Science
1.6 Program of study / Qualification	Telecommunications / Master
1.7 Form of education	Full time
1.8 Subject code	TC-E11.40

2. Data about the subject

2.1 Subject name	Management and Orchestration in Cloud						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Professor Virgil DOBROTA, Ph.D. Virgil.Dobrota@com.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Professor Virgil DOBROTA, Ph.D. Virgil.Dobrota@com.utcluj.ro						
2.5 Year of study	1	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DA/DO

3. Estimated total time

3.1 Number of hours per week	4	of which: 3.2 course	1	3.3 laboratory	2
3.4 To Total hours in the curriculum	42	of which: 3.5 course	14	3.6 laboratory	28
Distribution of time					hours
Manual, lecture material and notes, bibliography					20
Supplementary study in the library, online specialized platforms and in the field					12
Preparation for seminars / laboratories, homework, reports, portfolios and essays					20
Tutoring					3
Exams and tests					3
Other activities:					
3.7 Total hours of individual study	58				
3.8 Total hours per semester	100				
3.9 Number of credit points	4				

4. Pre-requisites (where appropriate)

4.1 curriculum	N. A.
4.2 competence	N. A.

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca
5.2. for the seminars / laboratories / projects	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	C4. Design, implementation and operation of data, voice, video, and multimedia services. This is based on the understanding and the application of fundamental concepts in telecommunications and transmission of information. C5. Selecting, installing, configuring, and operating fixed or mobile telecommunications equipment. Equipping a site with usual telecommunications networks
Cross competences	N.A.

7. Discipline objectives (as results from the key competences gained)

7.1 General objective	Development of professional skills regarding management and orchestration of virtual resources in cloud-based environments.
7.2 Specific objectives	<ol style="list-style-type: none"> 1. Understanding the core concepts of cloud computing, virtualization, container orchestration, network management and IT automation. 2. Development of skills and abilities necessary to use, orchestrate and manage cloud resources with OpenStack, Open-Source MANO, Terraform and Ansible. 3. Development of skills and abilities necessary to deploy and orchestrate a containerized software application. 4. Development of skills and abilities necessary to make basic configurations in software defined networks using OpenFlow protocol.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. History and Evolution of Cloud Computing	The discipline content and the acquired skills agree with the expectations of the professional	The discipline content and the acquired skills agree with the expectations of the professional
2. Cloud Deployment and Service Models		
3. Cloud-native Software Development		
4. Introduction to Virtualization. Hypervisors. Types of virtualization. Containers. Serverless Computing		
5. Virtual Machine vs Container Orchestration		
6. Kubernetes: Basics, Architecture, Objects		
7. Kubernetes: Storage, Configuration, Security		
8. Network Function Virtualization (NFV): Introduction, Architecture		
9. Network Function Virtualization (NFV): NFV Infrastructure, Virtual Infrastructure Manager, NFV Orchestration		

10. Software Defined Networking: Architecture, Controllers, Protocols		
11. Software Defined Networking: OpenFlow Protocol		
12. IT Automation: Infrastructure-as-Code (IAC) and Configuration Management		
13. Future Trends in Cloud Computing		
14. Recap. Examples of subjects from the previous year's exam.		
Bibliography <ol style="list-style-type: none"> 1. T. Erl, E. Monroy, "Cloud Computing: Concepts, Technology, Security, and Architecture", Second Edition, Pearson Education, 2023. 2. C. Jackson, J. Gooley, A. Iliesiu and A. Malegaonkar, "Cisco Certified DevNet Associate DEVASC 200-901 Official Cert Guide", Cisco Press, 2020. 3. M. Luksa, "Kubernetes in Action", First Edition, Manning Publications, 2018. 		
Online references <ol style="list-style-type: none"> 4. M. Luksa, "Kubernetes in Action", Second Edition, Manning Publications, 2024, [Online], Available: https://livebook.manning.com/book/kubernetes-in-action-second-edition/ 5. "Kubernetes Documentation", Kubernetes.io, 2024, [Online], Available: https://kubernetes.io/docs/home/. 		
8.2 Laboratory	Teaching methods	Notes
1. OpenStack private cloud orchestrator. OpenStack architecture. Create deploy and launch virtual instances in OpenStack.	Practical experiments on physical, virtual, cloud and emulator equipment.	N/A
2. Windows and Linux Hypervisors. Experiments with VMware, VirtualBox and Linux KVM.		
3. Experiments with Docker and Linux containers (LXC)		
4. Kubernetes orchestrator. Introduction to YAML Manifests.		
5. Introduction to Open Source MANO. Orchestration of virtual network functions		
6. Introduction to RYU OpenFlow controller and Mininet simulator. Experiments with OvS switches managed by RYU		
7. IT automation tools. Provisioning and deploying virtual resources in OpenStack with Terraform and Ansible		
8. Project work, stage 1: documentation		
9. Project work, stage 2: scenario		
10. Project work, stage 3: configuration		
11. Project work, stage 4: cloud configuration		
12. Project work, stage 5: captures and final configuration		
13. Additional work on projects (optional). Laboratory recoveries		
14. Project defending		
Bibliography <ol style="list-style-type: none"> 1. T. Erl, E. Monroy, "Cloud Computing: Concepts, Technology, Security, and Architecture", Second Edition, Pearson Education, 2023. 2. C. Jackson, J. Gooley, A. Iliesiu and A. Malegaonkar, "Cisco Certified DevNet Associate DEVASC 200-901 Official Cert Guide", Cisco Press, 2020. 3. M. Luksa, "Kubernetes in Action", First Edition, Manning Publications, 2018. 		
Online references <ol style="list-style-type: none"> 4. "OpenStack Documentation", OpenStack 2024, [Online], Available: https://docs.openstack.org/latest. 5. "Docker Documentation", Docker 2024, [Online], Available: https://docs.docker.com/. 		

6. "Kubernetes Documentation", Kubernetes, 2024, [Online], Available: <https://kubernetes.io/docs/home/>.
7. "Open-Source MANO (OSM) Project", ETSI 2024, [Online], Available: <https://osm.etsi.org/>.
8. "Ryu Documentation", Ryu, 2024, [Online], Available: <https://ryu.readthedocs.io/en/latest/>.
9. "Ansible Documentation", Ansible, 2024, [Online], Available: <https://docs.ansible.com/>.
10. "Terraform Documentation", HashiCorp 2024, [Online], Available: <https://developer.hashicorp.com/terraform/docs>.

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

The discipline content and the acquired skills are in agreement with the expectations of the professional Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Theoretical Test (mark T) : 10 questions with multiple choice answers + 4 problems	T, max 10 pct. 50%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	Project (P): oral and practical exam based on laboratory and project (usually 2p is granted for work during the semester).	P, max. 10 pct. 50%
10.6 Minimum standard of performance			
<p>Qualitative point of view</p> <p><i>Minimal theoretical and practical knowledge:</i></p> <ul style="list-style-type: none"> ✓ Understanding the basic concepts regarding management and orchestration of virtual resources in public or private cloud. ✓ Understanding the principles of NFV and SDN. <p><i>Minimal acquired competences:</i></p> <ul style="list-style-type: none"> ✓ Ability to deploy and orchestrate an application with Docker and Kubernetes in Cloud environments. ✓ Ability to provision and deploy virtual resources with Ansible and Terraform in Cloud environments. <p>Quantitative point of view</p> <ul style="list-style-type: none"> ✓ $N=(T+P)/2$, $N \geq 5$, $T \geq 5$, $P \geq 5$ 			

Date of filling in:	Responsible	Title First name SURNAME	Signature
20.06.2024	Course	Professor Virgil DOBROTA, Ph.D.	
	Applications	Professor Virgil DOBROTA, Ph.D.	

Date of approval in the Council of the Communications Department 10.07.2024	Head of Communications Department Prof. Virgil DOBROTA, Ph.D.
Date of approval in the Council of the Faculty of Electronics, Telecommunications and Information Technology 11.07.2024	Dean Prof. Ovidiu POP, Ph.D.