# COMPUTER ENGINEERING (LM75)

(Lecce - Università degli Studi)

## Teaching NETWORK TECHNOLOGIES AND DESIGN

GenCod A006806

**Owner professor** Giovanni CICCARESE

**Teaching in italian** TECNOLOGIE E PROGETTAZIONE DI RETI

**Teaching** NETWORK TECHNOLOGIES AND DESIGN

**SSD code** ING-INF/05

**Reference course** COMPUTER ENGINEERING

**Course type** Laurea Magistrale

**Credits** 9.0

**Teaching hours** Front activity hours: 81.0

**For enrolled in** 2022/2023

**Taught in** 2023/2024

**Course year** 2

**Language** ITALIAN

**Curriculum** PERCORSO COMUNE

**Location** Lecce

**Semester** Second Semester

**Exam type** Oral

**Assessment** Final grade

**Course timetable** https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

This course proposes the study of some fundamental aspects of the operation of modern computer networks, such as traffic control and quality of service, the support of wireless and mobile communications, security. The study includes the analysis of the network technologies which represent the state of the art on the above issues and a computer networks design methodology supported by a number of case studies which concern the selection of the most appropriate technologies depending on their operating contexts. Particularly, the criteria for designing network systems that meet given requirements in terms of performance, reliability and availability are discussed.

REQUIREMENTS

Fundamentals of Computer Networking, Probability Theory, Markov Chains

COURSE AIMS

**Learning Outcomes**.

***Knowledge and understanding***

After the course the student should

- understand the main issues regarding the operation of a modern computer network and how they could be addressed in order to ensure appropriate delivery of the application services;
- know the technologies to be considered in designing a modern computer network and, particularly, understand how they address the aforementioned issues;
- know what techniques can be adopted to model and analytically evaluate performance, reliability and availability of network systems.

***Applying knowledge and understanding***

After the course the student should be able to

- design a computer network with given requirements, selecting the most appropriate technologies depending on the operating context;
- configure network devices in a campus network for high availability;
- understand scientific literature on the modeling of performance, reliability and availability of network systems.

***Making judgements***

Students should acquire the ability to identify the pros and cons of each possible solution for both the logical network design and the physical network design. This also applies to the probabilistic techniques described during the lectures with regard to the modeling of performance, reliability, and availability. It is desiderable that students are interested in looking for other techniques by consulting specialized literature.

***Communication***

After the course the student should have a good command of topics covered in the course, so as to be able to communicate his/her knowledge and solutions in a clear and simple way, using the specific terminology. The course promotes the development of that skill.

***Learning skills***

With the aim of developing learning skills that allow students to continue to study in a way that can be largely autonomous, the instructor suggests some selected technical readings whose level of difficulty is significantly higher than that associated with the exercises covered during the course. They deal with the definition of performance models and/or availability models of large, real-world systems.

TEACHING METHODOLOGY

Lectures and exercises.

ASSESSMENT TYPE

The exam is oral. First, the student is asked to solve an exercise in order to verify his/her knowledge and understanding about the stochastic modeling of the performance, reliability and availability of network systems. The remaining part of the exam aims at assessing his/her knowledge and understanding about the issues related to the operation of modern computer networks, about the network technologies studied during the course and about the criteria for their selection in the network design process. Moreover, the student may also be asked to configure some protocols, such as HSRP and RSTP, on the network devices of a campus network for high availability simulated by means of a visual network simulation tool.

OTHER USEFUL INFORMATION

**Office Hours**
On Wednesdays, from 15:30 to 18:00

FULL SYLLABUS

**Course content: theory**

- Introduction to the course.
- Congestion Control and Traffic Control: principles of congestion control, approaches towards congestion control, flow control and congestion control in TCP, TCP/IP ECN.
- Multicast in the Internet: algorithms for multicasting, multicast in the Internet (multicast addresses in IPv4, IGMP, multicast routing protocols).
- IPv6: IPv6 addressing, IPv6 packet format, ICMPv6, transition from IPv4 to IPv6.
- Quality of Service (QoS) in IP networks: multimedia networking applications, protocols for real-time conversational applications(RTP, RTCP,SIP), Quality of Service, Queuing Disciplines, Shaping, Policing, Tocken Bucket, QoS in IP networks (RED, IntServ, DiffServ), MPLS.
- Wireless and Mobile Networks: wireless channel characteristics, Wireless LANs and IEEE 802.11, CAPWAP, planning a wireless access network, Mobile IPv6, Vehicular Ad Hoc Networks and IEEE 802.11p.
- Network Design: capacity planning, reliability, availability,switched LANs with redundant links (STP, RSTP), Virtual LANs, IEEE 802.1Q, Multiple Spanning Tree Protocol, Private Virtual LANs, Default Router redundancy (HSRP, VRRP, GLBP), Ipsec VPNs, top-down network design (design requirements, logical design, physical design, test plan and documentation).

**Course content: exercises**
On the design of modern computer networks
- A number of case studies which concern the selection of the most appropriate technologies depending on their operating contexts are
discussed. Moreover, configuration of network devices in a campus network for high availability is considered.
- By using some probabilistic techniques that are commonly employed for modeling computer networks and protocols (Markov Chains,
Reliability Block Diagrams, Queueing Theory), a number of examples dealing with modeling of performance, reliability and availability
of network systems are proposed.

REFERENCE TEXT BOOKS

[1] J. Kurose e K.W. Ross, “Computer Networking. A Top-Down Approach”, eighth edition, Pearson.
[2] P. Oppenheimer, “Top-Down Network Design”, third edition, Cisco Press.
[3] M. Baldi, P. Nicoletti, “Switched LAN”, McGraw-Hill
[4] S. Convery, “Network Security Architecture”, Cisco Press.
[5] G. Bolch, S. Greiner, H. de Meer, K.S. Trivedi, "Queueing Networks and Markov Chains: Modeling and Performance Evaluation With Computer Science Applications", Wiley-Interscience.
[6] K. Trivedi, A. Bobbio, "Reliability and Availability Engineering: Modeling, Analysis, and Applications", Cambridge University Press.
[7] E. Bauer, E. Adams, “Reliability and Availability of Cloud Computing”, Wiley-IEEE Press