Italian code: ING-INF/05 (old) – IINF-05/A (new)	**Credits: 9**
Course: Computer Networks	
Main language of instruction: Italian	
Other language of instruction: English	

Head instructor
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Objectives

The Computer Networks course is designed to provide a theoretical and practical foundation for understanding the architecture and operation of computer networks, as well as the fundamental elements of their design.
The course introduces the basic concepts of layered architecture and applies them to the study of protocols and, more generally, mechanisms commonly used in packet-switched networks, with particular reference to the Internet and the TCP/IP protocol suite. The course also introduces the fundamentals of traffic analysis using Wireshark and network security. The hands-on activities (E-activities) associated with the course are designed to reinforce the skills acquired in the lectures.

Course structure
- Introduction to Computer Networks
- Link Layer
- Network Layer
- Transport Layer
- Application Layer
- Network Traffic Analysis
- Fundamentals of Network Security

Competencies

A. Knowledge and understanding:
At the end of the course, the student will have acquired a knowledge of the problems related to the functioning of the different layers of the protocol stack in network architectures, with special reference to the Internet architecture. The

student will develop the ability to understand fundamental issues such as: the origin of delays and losses in packet transmission, the problems associated with reliable transport of data over an untrusted channel, the principles of addressing and routing in the Internet, the challenges associated with data transmission in local area networks, and issues related to network security. Through the practical activities (e-activities), the student will consolidate the knowledge acquired during the course.

B. Applying knowledge and understanding:

The student will be able to apply the knowledge gained to analyze and solve computer networking problems. Specifically, the student will be able to use traffic analysis tools such as Wireshark to diagnose network problems, interpret captured packets, and evaluate network performance. He/she will be able to perform calculations related to network sizing, IP address planning, and estimating expected performance. He/she will also know how to identify potential security vulnerabilities in a network and propose appropriate solutions to mitigate them. The skills acquired will enable the student to independently deal with the design of small and medium-sized networks, taking into account reliability, performance and security requirements.

C. Making judgements:

The student will be able to identify and select the most appropriate network protocols for the services to be implemented, critically analyzing their compliance with functional and performance requirements. Develop the ability to interpret and evaluate key network performance indicators (such as throughput, latency, jitter, and packet loss) and understand their interrelationships and impact on quality of service. They will also be able to gather and analyze the data required to design and configure a local area network, taking into account aspects such as topology, scaling, segmentation and security requirements.

D. Communication skills:

The student will be able to describe and maintain conversations on topics related to designing and managing a network and solving typical problems on a simple local area network using appropriate terminology.

E. Learning skills:

At the end of the course, the student will have acquired the fundamental knowledge necessary for the analysis and design of computer networks. He/she will be able to identify and understand the interactions between the different layers of the protocol stack in layered architectures, with particular reference to the Internet, and

evaluate the differences between different network architectures and service models. These competencies will provide the necessary foundation for subsequent specialized courses in Computer Engineering, particularly those related to the design and programming of distributed systems and applications, as well as the study of advanced network protocols not covered in this course.

Syllabus

Subject 1 - Introduction to Computer Networks: Definition, Basics, Functions Offered and Architecture of Computer Networks; Definition of Protocol, Layered Architecture and Protocol Stack; Introduction to TCP/IP Suite; Performance Parameters of Networks: Delay, Overhead.

Subject 2 - Link Layer: Services offered by the link layer; Techniques for detecting and correcting errors in transmitted data; Multiple access protocols to the means: channel splitting, random access and controlled access; MAC addresses; Ethernet: basics, framing, switches; VLANs.

Subject 3 - Network Layer 1 - Data Plane: Services Provided by the Network Layer; IPv4 Protocol: Datagram, Host and Network Addresses, Subnetting, Routing; Address Resolution Protocol (ARP); ICMP; Introduction to IPv6.

Subject 4 - Network Layer 2 - Control Plane: Routing Algorithms; Routing on the Internet: RIP, OSPF, BGP.

Subject 5 - Transport Layer: Services Provided by the Transport Layer; UDP; TCP; NAT; DHCP.

Subject 6 - Application Layer: Network Application Architectures; Introduction to Network Programming; Web and HTTP; DNS.

Subject 7 - Traffic Analysis: Introduction to Wireshark.

Subject 8 - Mobile Networks: Introduction to Wireless and Mobile Networks.

Subject 9 - Network Security: Introduction to Confidentiality and Authentication through Encryption; Firewall; TLS and SSH.

Evaluation system and criteria

The examination consists of a written test aimed at assessing the ability to analyze and revise the concepts acquired. In accordance with the pedagogical model of the course, the final evaluation of the course, expressed in thirtieths, also takes into account the evaluation of the proposed E-tivities (described in detail in the form of each E-ctivity).

The written test provides for the assignment of a maximum of 25 points, while each E-tivity provides for the assignment of a maximum of 3 points.

The expected learning outcomes in terms of subject knowledge and ability to apply it are assessed in the written test, while communication skills, autonomy of judgment (also understood as ability to draw conclusions) and self-learning ability are assessed in the itinerary of the E-tivities.

Bibliography and resources

1. *Materials to consult*

Slides and recorded lessons are available in Italian.

2. *Recommended bibliography*

- James F. Kurose, Keith W. Ross - Computer Networking: A Top-Down Approach