Networks

Module Description

Module code	CS301-F28	**Credits**	6 ECTS
Programme	Foundation programme	**Level**	Semester 5
Semester	Fall 2028	**Prerequisites**	CS204-S28 Operating Systems
Module leader	Dr. Ali Khudiyev	**Email**	ali.khudiyev@wosm.academy
Office hours	Monday–Friday, 10:00–17:00 (Baku time, UTC+4)		

1. Module Overview

This module explains how the Internet works, from the applications you use every day down to the links that carry bits between machines. It follows the layered architecture of the Internet from the top down: the application, transport, network and link layers, with the problems each layer solves and the protocols that solve them.

You will see why reliable communication over an unreliable network is possible, how TCP shares bandwidth fairly, how routers find paths across the Internet, and how local networks deliver frames. You will also write networked programs in C with the POSIX sockets interface. The module ends with the basics of network security.

2. Aims

- Explain the architecture of the Internet and the principles behind its protocols.
- Show how key protocols at each layer work and why they were designed as they were.
- Give practical experience of writing and analysing networked programs.
- Introduce the security threats networks face and the basic defences against them.

3. Learning Outcomes

After completing this course, you will be able to:

LO1. Explain layered network architectures and encapsulation, and calculate delay, loss and throughput in packet-switched networks.

LO2. Explain application-layer protocols such as HTTP and DNS, and write client and server programs in C with the sockets interface.

LO3. Explain and analyse transport-layer mechanisms: multiplexing, reliable data transfer, and TCP flow and congestion control.

LO4. Explain IP addressing and forwarding, perform subnetting, and analyse link-state and distance-vector routing, OSPF and BGP.

LO5. Explain link-layer functions: error detection, multiple access, Ethernet, switching and ARP.

LO6. Explain the basic principles of network security, including cryptography, TLS and firewalls.

4. Syllabus

Unit	Topic
1	Introduction: the Internet, packet switching; delay, loss and throughput
2	Protocol layering and encapsulation
3	Application layer I: HTTP and the web
4	Application layer II: DNS, email, peer-to-peer and content distribution
5	Socket programming in C: TCP and UDP clients and servers
6	Transport layer: multiplexing, UDP, principles of reliable data transfer
7	TCP: connection management and flow control
8	Congestion control
9	Network layer: forwarding, IPv4, addressing and subnetting, NAT, IPv6
10	Routing algorithms: link state and distance vector
11	Routing in the Internet: OSPF, BGP; software-defined networking
12	Link layer: error detection and correction, multiple access protocols
13	Ethernet, switches, ARP and VLANs
14	Wireless and mobile networks
15	Network security: cryptography basics, TLS, firewalls
16	Course Review & Exam

5. Teaching and Learning Methods

The module is self-paced. All materials are provided on Moodle. Each unit has a lecture and exercises. Practical tasks include writing socket programs in C and capturing and analysing real network traffic with a packet analyser such as Wireshark.

Activity	Hours
Lectures	32
Labs / Tutorials	32
Independent study	116
Total	**180**

6. Assessment

Your knowledge will be assessed throughout the course with quizzes, practical assignments and the final exam. The exam checks whether you can explain how protocols work and solve quantitative problems on delay, throughput, addressing and routing. The practical assignments check whether you can write and analyse networked programs.

Component	Weight	Due	LOs
Quizzes	20%	Throughout	LO1–LO6
Practical assignments	40%	Throughout	LO2, LO3
Final exam	40%	End of module	LO1–LO6
Total	**100%**		

7. Reading List

Essential

- J. F. Kurose, K. W. Ross: *Computer Networking: A Top-Down Approach*, 8th ed., Pearson, 2021.

Recommended

- L. L. Peterson, B. S. Davie: *Computer Networks: A Systems Approach*, 5th ed., Morgan Kaufmann, 2011. Updated edition free online at `https://book.systemsapproach.org`.
- A. S. Tanenbaum, N. Feamster, D. J. Wetherall: *Computer Networks*, 6th ed., Pearson, 2021.
- K. R. Fall, W. R. Stevens: *TCP/IP Illustrated, Volume 1: The Protocols*, 2nd ed., Addison-Wesley, 2011.
- W. R. Stevens, B. Fenner, A. M. Rudoff: *UNIX Network Programming, Volume 1: The Sockets Networking API*, 3rd ed., Addison-Wesley, 2003.

8. Materials and Licence

Course materials are published under the Creative Commons Attribution-ShareAlike 4.0 licence unless stated otherwise. See wosm.academy/licence for details.

9. Policies

- **Attendance:** Attendance is not mandatory. The module is self-paced, so you can study the materials when it suits you.
- **Late submissions:** Work submitted after the deadline is penalised.
- **Academic integrity:** All submitted work must be your own. See the Code of Conduct.