Management Information Systems
UMI224 - COMPUTER NETWORK SYSTEMS
Course Syllabus

1. Course Information

Course Title	Computer Network Systems
Course Code	UMI224
Program	Management Information Systems
Contact Hours	3 hours/week (3+0)
Duration	14 weeks
ECTS	4.0
Course Type	Compulsory
Instructor	Dr. Yakup Bakis
Required Textbook	Kurose & Ross, Computer Networking: A Top-Down Approach (8th Edition)

2. Objectives of the Course Unit

This course unit aims to introduce students to the architecture and core protocols of modern computer networks, with a primary focus on the Internet and the TCP/IP protocol stack.
It aims to develop a structured understanding of layered communication, including the Application Layer, Transport Layer, and Network Layer (Data Plane), and to help students interpret how data is generated, transmitted, forwarded, and delivered across networks.
The course also aims to build foundational knowledge of key Internet protocols and services (such as HTTP, DNS, email, UDP, TCP, IP, NAT, and IPv6), while improving students' ability to analyze basic network performance concepts such as delay, throughput, and packet loss.
In addition, the course aims to provide students with a basic conceptual background for socket programming and network application development.

3. Contents of the Course Unit

This course introduces the architecture, operation, and core protocols of modern computer networks, with a primary focus on the Internet and the TCP/IP protocol stack.
Students develop a structured understanding of how data is generated, encapsulated, transmitted, forwarded, and delivered across networks—from end systems to routers—through layered network communication.

The course begins with foundational concepts in computer networks and the Internet, including end systems, access networks, physical media, packet switching and circuit switching, the network core, and basic performance metrics such as delay, throughput, and packet loss. Students also examine layered architecture and encapsulation to understand how protocol layers interact in end-to-end communication.

In the **Application Layer**, students study the principles of network applications and core Internet application protocols, including the Web and HTTP, electronic mail (SMTP and mail access protocols), and DNS. The course emphasizes how application requirements relate to transport services and how communication processes interact in client-server style networked systems.

In the **Transport Layer**, students examine transport services and protocol mechanisms, including multiplexing and demultiplexing, UDP, port numbers, checksum basics, and the principles of reliable data transfer. The course also introduces TCP fundamentals, including segment structure, round-trip time and timeout concepts, flow control, and connection management, with an introductory view of congestion control.

In the **Network Layer (Data Plane)**, students study the role of the network layer, the distinction between forwarding and routing from a data-plane perspective, and a basic overview of router internals. The course further covers core Internet Protocol concepts, including the IPv4 datagram format, IPv4 addressing, CIDR/subnetting basics, NAT, and an introduction to IPv6. The semester concludes with an introductory overview of generalized forwarding, SDN concepts, and middleboxes, together with an integrated course review.

Homework assignments and short practical exercises are designed to support conceptual understanding, protocol interpretation, and basic hands-on analysis of network communication behavior.

4. Contribution of the Course Intending to Provide the Professional Education

This course contributes to professional education by providing students with a strong foundation in computer networking concepts and Internet protocol operation. It supports the development of analytical and technical thinking skills required for understanding how modern digital systems communicate across networks.

By studying the Application Layer, Transport Layer, and Network Layer (Data Plane), students gain the ability to interpret network behavior, identify basic communication problems, and evaluate protocol-level interactions in software and system environments. The course also strengthens students' capacity to work with network-aware applications by introducing the conceptual basis of socket programming and end-to-end communication.

In professional practice, this course helps students communicate more effectively with software, system, and network teams; understand the network-related requirements of digital services; and make more informed technical decisions in areas such as performance, reliability, and connectivity. It therefore provides essential background knowledge for further study and professional work in software development, information systems, and networked computing environments.

5. Key Learning Outcomes of the Course Unit

- **Explain** the basic concepts and functions of TCP/IP layers.
- **Interpret** the working principles of network protocols and understand basic protocol design logic.
- **Compare** network applications and architectures (e.g., client-server and P2P) at a conceptual level.
- **Explain** the basic socket programming approach and the logic of network application development.
- **Analyze** core network performance and troubleshooting concepts (e.g., delay, throughput, packet loss).
- **Interpret and apply** basic network-layer data-plane concepts such as IPv4 addressing, NAT, and IPv6.
- **Explain** layered communication concepts such as encapsulation and distinguish forwarding and routing at a basic level.

6. Weekly Course Contents and Study Materials for Preliminary & Further Study (14 Weeks)

Week	Title	Topics	Textbook Mapping	Hours
1	Introduction	Course introduction, evaluation, basic networking concepts, top-level TCP/IP and OSI overview, key terms	Ch1 (intro): 1.1, 1.1.3, 1.5 (intro level)	3
2	Computer Networks and the Internet (1)	Internet structure, end systems, access networks, physical media, packet switching vs circuit switching	Ch1: 1.1.1, 1.1.2, 1.1.3, 1.2, 1.2.1, 1.2.2, 1.3.1, 1.3.2	3
3	Computer Networks and the Internet (2)	Network core, network of networks, delay types, packet loss, throughput	Ch1: 1.3.3, 1.4, 1.4.1-1.4.4	3
4	Computer Networks and the Internet (3)	Layered architecture, encapsulation, brief security awareness, short history, review of Weeks 1-4	Ch1: 1.5.1, 1.5.2 (core); brief awareness linkage to 1.6, 1.7 if time	3
5	Application Layer (1)	Network application architectures, process communication, application requirements, application-layer protocol logic	Ch2: 2.1, 2.1.1-2.1.6	3
6	Application Layer (2)	Web and HTTP, HTTP message structure, persistent/non-persistent connections, cookies, caching, HTTP/2 (conceptual)	Ch2: 2.2, 2.2.1-2.2.6	3

7	Application Layer (3)	Email architecture (SMTP, mail access), DNS working logic, preparation for socket programming	Ch2: 2.3 and 2.4 (core focus); minimum required: 2.4, 2.4.1-2.4.3	3
8	Midterm Exam	Coverage of Weeks 1-7 (especially Ch1-Ch2 and basic layer/protocol concepts)	Ch1-Ch2 review	3
9	Transport Layer (1)	Transport services, multiplexing/demultiplexing, UDP, port numbers, checksum	Ch3: 3.1, 3.2, 3.3, 3.3.1, 3.3.2	3
10	Transport Layer (2)	Reliable Data Transfer principles, ARQ logic, pipelining, GBN, SR	Ch3: 3.4, 3.4.1-3.4.4	3
11	Transport Layer (3)	TCP basics, TCP segment structure, RTT/timeout, flow control, connection management, intro to congestion control	Ch3: 3.5, 3.5.1-3.5.6	3
12	Network Layer: Data Plane (1)	Network layer overview, forwarding vs routing, data/control plane distinction, router internals overview	Ch4: 4.1, 4.1.1, 4.1.2, 4.2, 4.2.1-4.2.5	3
13	Network Layer: Data Plane (2)	IPv4 datagram format, IPv4 addressing, CIDR/subnetting basics, NAT, introduction to IPv6	Ch4: 4.3, 4.3.1-4.3.4	3
14	Network Layer: Data Plane (3) + Wrap-up	Generalized forwarding and SDN introduction, middleboxes, course review and final exam preparation	Ch4: 4.4, 4.4.1-4.4.3, 4.5/4.6 (middleboxes, edition numbering may vary)	3

7. Assessment and Grading

The grading structure below is suitable for a 3-hour/week format and supports steady progress throughout the semester.

Component	Weight
Midterm Exam	30%
Final Exam	40%
Quizzes (2 short quizzes)	10%
Assignments	10%
Final Mini-Project (network observation report)	10%

Assignment guidance:

- Optional textbook end-of-chapter problems may be assigned as practice.
- Required assignments will be short and focused to fit the 3-hour/week schedule.
- The final mini-project may include a short traceroute and/or Wireshark-based observation report.

- Sample homework topics:

1. HTTP request/response header analysis
2. Explanation of DNS resolution flow
3. TCP and UDP comparison report
4. Basic subnetting/NAT application questions
5. Simple socket programming mini application (optional)

8. SOURCE MATERIALS & RECOMMENDED READING

- Kurose, J. F., & Ross, K. W. (2021). *Computer Networking: A Top-Down Approach* (8th ed.).
- Instructor lecture notes and presentation slides.
- Short protocol analysis handouts (HTTP, DNS, TCP/UDP, IP addressing).
- Optional practice materials: Wireshark-based observation tasks, traceroute demonstrations.
- Selected end-of-chapter exercises.