<table>
<tr><td rowspan="7">Identification</td><td>Subject</td><td>CMS 309: Computer Networks - 6ECTS</td></tr>
<tr><td>Group</td><td>A</td></tr>
<tr><td>Department</td><td>Computer Science and Engineering</td></tr>
<tr><td>Program</td><td>Undergraduate</td></tr>
<tr><td>Term</td><td>Fall, 2023</td></tr>
<tr><td>Instructor</td><td>Hafiz Muhammad Azeem Akram</td></tr>
<tr><td>E-mail:</td><td>a.akram@khazar.org</td></tr>
<tr><td>Classroom/hours</td><td>11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), Classroom: N402</td></tr>
<tr><td>Prerequisites</td><td colspan="2">English proficiency</td></tr>
<tr><td>Language</td><td colspan="2">English</td></tr>
<tr><td>Compulsory/Elective</td><td colspan="2">Required</td></tr>
<tr><td>Required textbooks and course materials</td><td colspan="2">Core textbooks:

1. James F. Kurose. Computer Networking, 8th Edition, Pearson; ISBN-13: 9780135928615
2. Andrew S. Tanenbaum. Computer Networks, 6th Edition, Pearson; ISBN-13: 9780137523214
3. Douglas E. Comer. Computer Networks and Internets, 6th Edition Pearson; ISBN-13: 13: 9781292061825</td></tr>
<tr><td>Course Description and outline</td><td colspan="2">This course covers the core theory of Computer Networks in order for students to understand the science underpinning computer communications, such as basic architectural principles of computer networking, including how the Internet works today and applications of theory in current technology. The course will cover the problems of Computer Networks and the standard ways to approach and resolve these problems, including relevant real-world, state-of-the-art examples. The practicals for the course will allow students to apply theory to real-world examples. In the course we cover general networking areas, concepts and common themes, and also work our way up the networking layers, examining the problems and solutions at each layer to allow us to build effective global networks. We will cover the following topics:
• Overview of computer networks and their significance in today's digital world.
• Study of network architecture models, with a focus on the OSI and TCP/IP models
• Examination of transmission media, signaling, and encoding techniques.
• In-depth coverage of data link layer protocols, error detection, and correction methods.
• IP addressing, subnetting, and CIDR.
• Exploration of routing algorithms and dynamic routing protocols like RIP and OSPF.
• Understanding the role of the transport layer in end-to-end communication.
• In-depth study of TCP and UDP protocols, including flow control and congestion control mechanisms.
• Exploration of high-level network protocols such as HTTP, FTP, SMTP, and DNS.
• Examination of wireless communication technologies, including Wi-Fi and cellular networks.
• Mobile IP and routing in mobile networks, along with the challenges they present.</td></tr>
<tr><td>Course objectives</td><td colspan="2">1. Develop a solid understanding of core networking principles, including the architectural foundations of computer networking, enabling students to grasp the science behind computer communications.
2. Gain the ability to identify, analyze, and solve common networking problems using established methods and state-of-the-art examples from real-world scenarios.
3. Bridge the gap between theory and practice by allowing students to apply their knowledge to practical, real-world examples through hands-on exercises and practical assignments.</td></tr>
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Learning outcomes	At the end of the course, students should be able to debug everyday networking issues they encounter, construct and debug a small-medium IP network, and understand the problems and common solutions for scaling networking globally.

Teaching methods	**Lecture**		x
	Group discussion		x
	Experiential exercise		x
	Lab		x
	Case analysis		
	Course paper		x
	Others		
Evaluation	**Methods**	**Date/deadlines**	**Percentage (%)**
	Project		30
	Quizx3		10
	Midterm Exam		30
	Final Exam		30
	Total		100

Policy

Project Description

In this project, students will use Wireshark to capture, analyze, and interpret multimedia traffic on a network. They will gain insights into how multimedia data is transmitted and how different protocols are used to deliver audio and video content over the internet.

Project Steps:

1. **Select Multimedia Services**: Choose specific multimedia services or applications to analyze. Examples include streaming video (e.g., YouTube, Netflix), VoIP (e.g., Skype, Zoom), online gaming, or video conferencing streaming or using the selected multimedia service. Ensure that Wireshark is properly set up to capture packets on the relevant network interface.
2. **Filter Multimedia Traffic**: Use Wireshark's display filters to isolate the multimedia traffic from the captured packets.
3. **Packet Inspection:** Analyze the captured multimedia packets. Examine various aspects of the traffic, including:

- Header information: Investigate the headers of the packets to understand the protocols in use (e.g., SIP for VoIP, HTTP for web streaming).
- Packet sequence: Analyze the order in which packets are transmitted and how they relate to each other.
- Payload analysis: Inspect the payload of packets to understand the actual multimedia data. For example, students can examine audio or video codec information.

4. **QoS Metrics**: Calculate and analyze QoS metrics like latency, jitter, and packet loss, which are critical for ensuring a smooth multimedia experience.
5. **Visualization**: Create visual representations of the analyzed data using tools like graphs or charts to illustrate trends and patterns in multimedia traffic.
6. **Documentation**: Document your findings and analysis in a report. Include details on the protocols used, network performance metrics, and any relevant findings.
7. **Presentation**: Each student or group should present their findings to the class, highlighting interesting insights and lessons learned during the multimedia traffic analysis.

Note: Project writing guide and grading policy will be shared in the Microsoft Teams group.

- **Preparation for class**
  The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems.

- **Withdrawal (pass/fail)**
  This course strictly follows grading policy of the School of Engineering and Applied Science. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.

- **Cheating/plagiarism**
  Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.

- **Professional behavior guidelines**
  The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.

- **Ethics**
  Students should not arrive late to class.
  All cell phones must be turned off and stowed away before entering class.
  Use of any electronic devices is not allowed in the classroom and violators will be punished accordingly.

WK	Date/Day (tentative)	Topics	Recommended Readings
1	19/09/2023 21/09/2023	• What Is the Internet • The Network Edge • The Network Core • Delay, Loss, and Throughput in Packet-Switched Networks	Lecture Slides Readings:1.1-1.4
2	26/09/2023 28/09/2023	• Protocol Layers and Their Service Models • History of Computer Networking and the Internet • Principles of Network Applications…	Lecture Slides Readings:1.5,1.6-2.1
3	03/10/2023 05/10/2023	• Principles of Network Applications • The Web and HTTP • Electronic Mail in the Internet	Lecture Slides Readings:2.1-2.3 **Quiz#01**
4	10/10/2023 12/10/2023	• DNS—The Internet's Directory Service • Peer-to-Peer File Distribution • Video Streaming and Content Distribution Networks	Lecture Slides Readings: 2.4-2.6
5	17/10/2023 19/10/2023	• Introduction and Transport-Layer Services • Multiplexing and Demultiplexing • Connectionless Transport: UDP	Lecture Slides Readings:3.1-3.3
6	24/10/2023 26/10/2023	• Principles of Reliable Data Transfer • Connection-Oriented Transport: TCP • Principles of Congestion Control…	Lecture Slides Readings:3.4-3.6
7	07/11/2023 09/11/2023	• Principles of Congestion Control • TCP Congestion Control • Revision	Lecture Slides Readings:3.6,3.7. **Quiz#02**
8		**Midterm Exam**	
9	14/11/2023 16/11/2023	• Overview of Network Layer • What's Inside a Router? • The Internet Protocol (IP): IPv4, Addressing	Lecture Slides Readings:4.1-4.3
10	21/11/2023 23/11/2023	• Generalized Forwarding and SDN • Middleboxes • Introduction to the Control Plane	Lecture Slides Readings:4.4,4.5,5.1
11	28/11/2023 30/11/2023	• Routing Algorithms • Intra-AS Routing in the Internet: OSPF • Routing Among the ISPs: BGP	Lecture Slides Readings:2.2-5.4
12	05/12/2023 07/12/2023	• The SDN Control Plane • ICMP: The Internet Control Message Protocol • Network Management and SNMP, NETCONF/YANG • Introduction to the Link Layer • Error-Detection and -Correction Techniques	Lecture Slides Readings:5.5-5.7 Readings: 6.1-6.2 **Quiz#03**
13	12/12/2023 16/12/2023	• Multiple Access Links and Protocols • Switched Local Area Networks • Link Virtualization: A Network as a Link Layer • Retrospective: A Day in the Life of a Web Page Request	Lecture Slides Readings: Chapter 6.2-6.7 **#Project Submission**
14	19/12/2023 21/12/2023	Cisco Packet Tracer Training (continue)	Labs
15	26/12/2023 28/12/2023	Project Demonstration Final Exam Review	
		Final Exam	

Note: This course outline is subject to change.