



**University of Tehran**  
**School of Electrical and Computer Engineering**

<b>Course:</b>	<b>8101072 – Computer Networks Lab</b>		
<b>Course type:</b>	Elective	CE,IT*	Credit: 3
<b>Level:</b>	Undergraduate		
<b>Co-requisite(s):</b>	NA		
<b>Prerequisite(s):</b>	Computer Networks		
<b>Prerequisite by topic:</b>	Basics of Networking		
<b>Textbook(s):</b>	S. Panwar , S. Mao , J. Ryoo , Y. Li , <b>TCP/IP Essentials: A Lab-Based Approach</b> , Cambridge University Press, 2004.		
<b>Coordinator:</b>	A. Khonsari, Associate Professor, School of ECE		
<b>Goals:</b>	<p>The TCP/IP family of protocols have become the de facto standard in the world of networking, are found in virtually all computer communication systems, and form the basis of today's Internet. In this course students become familiar with different aspects of networking through a series of extensively tested laboratory experiments that span the various elements of protocol definition and behavior. Topics covered include bridges, routers, LANs, static and dynamic routing, multicast and real-time service, and network management and security. The experiments are described in a Linux environment. The audience of the course are students of electrical and computer engineering and students of computer science taking courses in networking.</p>		
<b>Outcome:</b>	<p>Upon successful completion of course requirements, students will understand and be able to :</p> <p>0- Getting acquainted with the Linux operating system.</p> <ol style="list-style-type: none"> <li>1. Identify and describe the functions of the layers of the TCP/IP reference model.</li> <li>2. Describe data link and network addresses and identify key differences between them.</li> <li>3. List the key internetworking functions of the TCP/IP Network layer.</li> <li>4. Describe the two parts of network addressing, then identify the parts in specific protocol address examples.</li> <li>5. Identify the functions of the TCP/IP network- layer protocols and</li> </ol>		

	<p>TCP and UDP services.</p> <p>6. Understand the functions of Bridges, LANs and the Cisco IOS and learn how to program a router.</p> <p>7. Learn the basics of static and dynamic routing protocols.</p> <p>8. Being familiar with broadcast and multicast functions of TCP/IP protocol stack and basics of multimedia applications.</p> <p>11. being familiar with the Web, DHCP, NTP and NAT, web server and basics of security concept in TCP/IP based networks.</p>
<p><b>Topics:</b></p>	<p><b>1 Linux and TCP/IP networking</b></p> <p><b>1.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ Getting acquainted with the lab environment.</li> <li>_ Getting acquainted with the Linux operating system.</li> <li>_ Preview of some TCP/IP diagnostic tools.</li> <li>_ Capturing and analyzing the link layer, IP, and TCP headers.</li> <li>_ Understanding the concept of encapsulation.</li> <li>_ Understanding the concept of multiplexing using port numbers, the IP <i>protocol</i> field, and the Ethernet <i>frame type</i> field.</li> <li>_ Understanding the client–server architecture.</li> </ul> <p><b>2 A single segment network</b></p> <p><b>2.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ Network interfaces and interface configuration.</li> <li>_ Network load and statistics.</li> <li>_ The Address Resolution Protocol and its operations.</li> <li>_ ICMP messages and Ping.</li> <li>_ Concept of subnetting.</li> <li>_ Duplicate IP addresses and incorrect subnet masks.</li> </ul> <p><b>3 Bridges, LANs and the Cisco IOS</b></p> <p><b>3.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ The Cisco Internet Operating System software.</li> <li>_ Configuring a Cisco router.</li> <li>_ Transparent bridge configuration and operation.</li> <li>_ The spanning tree algorithm.</li> </ul> <p><b>4 Static and dynamic routing</b></p> <p><b>4.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ Comparison of router and bridge.</li> <li>_ IP forwarding.</li> <li>_ Use of ICMP messages in routing.</li> <li>_ The Routing Information Protocol (RIP).</li> <li>_ The Open Shortest Path First (OSPF) protocol.</li> <li>_ Static routing by manually building the routing tables in the routers and hosts.</li> <li>_ Use of Traceroute to find an end-to-end route.</li> </ul> <p><b>5 UDP and its applications</b></p> <p><b>5.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ Study <b>sock</b> as a traffic generator, in terms of its features and command line options.</li> <li>_ Study the User Datagram Protocol.</li> <li>_ IP fragmentation.</li> </ul>

	<ul style="list-style-type: none"> <li>_ MTU and path MTU discovery.</li> <li>_ UDP applications, using the Trivial File Transfer Protocol as an example.</li> <li>_ Compare UDP with TCP, using TFTP and the File Transfer Protocol.</li> </ul> <p><b>6 TCP study</b></p> <p><b>6.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ TCP connection establishment and termination.</li> <li>_ TCP timers.</li> <li>_ TCP timeout and retransmission.</li> <li>_ TCP interactive data flow, using <b>telnet</b> as an example.</li> <li>_ TCP bulk data flow, using <b>sock</b> as a traffic generator.</li> <li>_ Further comparison of TCP and UDP.</li> <li>_ Tuning the TCP/IP kernel.</li> <li>_ Study TCP flow control,</li> </ul> <p><b>7 Multicast and real-time service</b></p> <p><b>7.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ Multicast addressing.</li> <li>_ Multicast group management.</li> <li>_ Multicast routing: configuring a multicast router.</li> <li>_ Real-time video streaming using the Java Media Framework.</li> <li>_ Protocols supporting real-time streaming: RTP/RTCP and RTSP.</li> <li>_ Analyzing captured RTP/RTCP packets using Ethereal.</li> </ul> <p><b>8 The Web, DHCP, NTP and NAT</b></p> <p><b>8.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ The Hypertext Transfer Protocol and the Apache web server.</li> <li>_ The Common Gateway Interface.</li> <li>_ The Dynamic Host Configuration Protocol.</li> <li>_ The Network Time Protocol.</li> <li>_ The Network Address Translator and the Port Address Translator.</li> <li>_ An introduction to socket programming.</li> </ul> <p><b>9 Network management and security</b></p> <p><b>9.1 Objectives</b></p> <ul style="list-style-type: none"> <li>_ SNMP and MIBs, using NET-SNMP as an example, and using NETSNMP utilities to query MIB objects.</li> <li>_ Encryption, confidentiality, and authentication, including DES, RSA, MD5 and DSS.</li> <li>_ Application layer security, using SSH and Kerberos as examples.</li> <li>_ Transport layer security, including SSL and the secure Apache server.</li> <li>_ Network layer security, IPsec and Virtual Private Networks.</li> <li>_ Firewalls and IPTABLES.</li> <li>_ Accounting, auditing, and intrusion detection.</li> </ul>
<b>Computer usage:</b>	none
<b>Assignments:</b>	9 lab reports
<b>Projects:</b>	none

<b>Grading:</b>	Lab attendance: 70% Final exam: 30%
<b>Further readings:</b>	Cisco router documents
<b>Prepared by:</b>	A. Khonsari
<b>Date:</b>	Dec. 10, 2009

\*EE: Electrical Engineering CE: Computer Engineering IT: Information Technology