Course Title: Data Communication and Networks

Course No.: ICT. Ed. 456
Level: Bachelor.
Semester: Fifth
Program: BICTE

Nature of course: Theoretical + Practical
Credit Hour: 3 hours (2T+1P)
Teaching Hour: 64hours (32+32)

1. Course Description

This course introduces the fundamental concepts on data communication, data transmission mechanisms, Network Architectures, Internet protocols, Local area networks and the practical aspects of networking. It also aims to develop networking skill such as sub-netting and network infrastructure design and development among students.

2. General Objectives

After successful completion of this course students will be able to

- Identify the different components and their respective roles in computer network and internet
- Explain different services provided by the Network Layers
- Design an enterprise network employing the WLAN, LAN and VLAN technologies and be able to evaluate the advantages and disadvantages
- Configure a PC to work as a host in a TCP/IP network and to use the IP based commands

3. Course Outlines:

Specific Objectives	Contents	Lecture Hrs
• Describe the basic concept of computer network and Internet • Explain layered architecture • Apply computer network skills for installation of Wireshark • Describe process and components of computer networking and install Wireshark for the networking	**Unit 1: Computer Networks and the Internet** 1.1. The Internet 1.2. The Network Edge : Access Networks, Physical Media 1.3. The Network Core : Packet Switching, Circuit Switching 1.4. Delay,Loss, and Throughput in Packet-Switched Networks 1.5. Protocol Layers and Their Service Models : Layered Architecture, Encapsulation 1.6. History of Computer Networking and the Internet **Practical Work** • Installation of Wireshark (free packet sniffer app) and able to use it	3+3

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• Describe different services provided by application layer • Identify different application layer protocols • Discuss and apply DNS, peer to peer file distribution and video streaming and content distribution networks • Apply of knowledge and skills for Netflix, youTube, and Wireshark Lab.	**Unit 2: Application Layer** 2.1. The Web and HTTP: overview of HTTP, HTTP Message Format, User-Server Interaction: Cookies, Web Caching 2.2. Electronic Mail in the Internet : SMTP, Mail Message Formats, Mail Access Protocols 2.3. DNS—The Internet's Directory Service 2.4. Peer-to-Peer File Distribution 2.5. Video Streaming and Content Distribution Networks **Case Studies:** • Netflix and YouTube **Practical Works:** • Wireshark Lab: HTTP and DNS	**5+5**
• Describe the basics of transport layer • Compare and contrast different aspect of TCP and UDP • Discuss connection less and connection-oriented transport • Apply knowledge and skills of transport layer for Wireshark Lab	**Unit 3: Transport Layer** 3.1. Introduction and Transport-Layer Services 3.1.1. Relationship Between Transport and Network Layers 3.1.2. Overview of the Transport Layer in the Internet 3.2. Multiplexing and De-multiplexing 3.3. Connectionless Transport: UDP 3.3.1. UDP Segment Structure 3.3.2. UDP Checksum 3.4. Principles of Reliable Data Transfer 3.4.1. Go-Back-N (GBN) 3.4.2. Selective Repeat (SR) 3.5. Connection-Oriented Transport: TCP 3.5.1. Round-Trip Time Estimation and Timeout 3.5.2. Reliable Data Transfer 3.5.3. Flow Control 3.6. TCP Congestion Control **Practical Works:** • Wireshark Lab: Exploring TCP and UDP	**6+6**

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• Describe the network layer data plane and control plane differently • Explain the router and different routing algorithms • Make distinction between IPv4 and IPv6 • Apply knowledge and skills of the network layer such Data Plane, Control Plan for Wireshark Lab as well as practicing sub-netting to create small networks	**Unit 4: The Network Layer** 4.1. Data Plane 4.1.1. Inside the Router 4.1.1.1 Input Port Processing and Destination Based Forwarding 4.1.1.2 Switching 4.1.1.3 Output Port Processing 4.1.1.4 Queuing 4.1.1.5 Packet Scheduling 4.1.2. The Internet Protocol (IP) 4.1.2.1 IPv4 Datagram Format 4.1.2.2 IPv4 Addressing 4.1.2.3 Subnetting 4.1.2.4 Network Address Translation (NAT) 4.1.2.5 IPv6 4.2. Control Plane 4.2.1. Routing Algorithms 4.2.1.1 The Link-State (LS) Routing Algorithm 4.2.1.2 The Distance-Vector (DV) Routing Algorithm 4.2.2. Intra-AS Routing in the Internet: OSPF 4.2.3. Routing Among the ISPs: BGP 4.2.4. ICMP: The Internet Control Message Protocol **Practical Works:** • Wireshark Lab: IP • Practice Sub-netting to create small networks	**8+8**
• Explain Link Layer protocols and services provided by link layer • Get insight and analyze error detection and error correction techniques • Explain DHCP, Ethernet technology and VLANs	**Unit 5: The Link Layer and LAN** 5.1. Introduction to the Link Layer 5.1.1 The Services Provided by the Link Layer 5.2. Error-Detection and -Correction Techniques 5.2.1 Parity checks 5.2.2 Check Sum Methods 5.2.3 Cyclic Redundancy Check (CRC) 5.3. Multiple Access Links and Protocols 5.3.1 Channel Partitioning Protocols	**6+6**

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• Apply knowledge and skills of the link layer and LAN including multiple access links and protocols switched local area networks, DNS, ARP and Web Client-Server Interaction for Wireshark Labs: 802.11 Ethernet	5.3.2 Random Access Protocols 5.3.3 Taking-Turns Protocols 5.3.4 DOCSIS: The Link-Layer Protocol for Cable Internet Access 5.4. Switched Local Area Networks 5.4.1 Link-Layer Addressing and ARP 5.4.2 Ethernet 5.4.3 Link-Layer Switches 5.4.4 Virtual Local Area Networks (VLANs) 5.5. A Day in the Life of a Web Page Request 5.5.1 DHCP, UDP, IP, and Ethernet 5.5.2 DNS and ARP 5.5.3 Intra-Domain Routing to the DNS Server 5.5.4 Web Client-Server Interaction: TCP and HTTP **Practical Works:** • Wireshark Labs: 802.11 Ethernet	
• Describe and apply Wireless technologies: WiFi and cellular networks • Apply knowledge and skills related to wireless and mobile networks for Wireshark Lab: Wif-Fi	**Unit 6: Wireless and Mobile Networks** 6.1. WiFi: 802.11 Wireless LANs 6.1.1 The 802.11 Wireless LAN Architecture 6.1.2 The 802.11 MAC Protocol 6.1.3 The IEEE 802.11 Frame 6.1.4 Mobility in the Same IP Subnet 6.1.5 Personal Area Networks: Bluetooth 6.2. Cellular Networks: 4G and 5G **Practical Works:** • Wireshark Lab: Wi-Fi	**4+4**

4 Instructional Techniques

The instructional techniques for this course are divided into two groups. First group consists of general instructional techniques applicable to most of the units. The second group consists of specific instructional techniques applicable to particular units.

4.1 General Techniques

Reading materials will be provided to students in each unit. Lecture, Discussion, use of multi-media projector, brain storming are used in all units.

4.2 Specific Instructional Techniques

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Demonstration is an essential instructional technique for all units in this course during teaching learning process. Specifically, demonstration with practical works will be specific instructional technique in this course. The details of suggested instructional techniques are presented below:

Unit 1: Assign students to prepare presentation on Internet
Unit 2: Self-study and ask students to prepare case study report on YouTube and Netflix
Unit 3: Homework and Assignment on TCP and UDP
Unit 4: Homework and Assignment on subnetting
Unit 5: Homework and Assignment on Error Detection and Correction Methods
Unit 6: Self-study and ask students to make detail report and presentation on Wireless Technologies: CDMA, 4G, 5G, WiFi: 802.11 Wireless LANs

5 Evaluation :

Internal Assessment	External Practical Exam/Viva	Semester Examination	Total Marks
40 Points	20 Points	40 Points	100 Points

***Note**: Students must pass separately in internal assessment, external practical exam and semester examination.*

a. Internal Evaluation (40 Points):

Internal evaluation will be conducted by subject teacher based on following criteria:

11) Class Attendance	5 points
12) Learning activities and class performance	5 points
13) First assignment (written assignment)	10 points
14) Second assignment (Case Study/project work with presentation)	10 points
15) Terminal Examination	10 Points
Total	40 points

b. Semester Examination (40 Points)

Examination Division, Dean office will conduct final examination at the end of semester.

3) Objective question (Multiple choice 10 questions x 1mark)	10 Points
4) Subjective answer questions (6 questions with 2 OR x 5 marks)	30 Points
Total points	40

c. External Practical Exam/Viva (20 Points):

Examination Division, Dean Office will conduct final practical examination at the end of semester.

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6 Prescribed Textbook, Recommended books and References materials (including relevant published articles in national and international journals)

Prescribed Text Book:

James F. Kurose & Keith W. Ross, Computer Networking: A Top-Down Approach, 8th Ed., Pearson Education

Recommended Books and Reference Materials:

Tanenbaum Andrew S., Computer Networks, 4th edition (2nd Impression 2006) or available latest edition

William Stallings, Data and Computer Communications, 7th Edition (3rd Impression 2007) or available latest edition

Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, 4th Edition

Halsall Fred, Data Communications, Computer Networks and OSI, 4th edition (10th Indian reprinting 2005)

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