

**Course Title: Data Communication and Networks**

Course No.: ICT. Ed. 456

Level: B.Ed.

Semester: Fifth

Nature of course: Theoretical + Practical

Credit Hour: 3 hours (2T+1P)

Teaching Hour: 80hours (32+48)

**1. Course Description**

The purpose of this course is to introduce the fundamental concepts on data communication, Data transmission mechanisms, Network architectures, Internet protocols, Local area networks and the practical aspects of networking. At the end of this course, a student will be able to understand the fundamental concepts required for the design, deployment, and management of computer networks.

**2. General Objectives**

After successful completion of this course students will be able to

- Identify the different components and their respective roles in a communication system
- Propose efficient, cost effective, reliable and appropriate technology to establish communication links
- Design an enterprise network employing the common LAN 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 to facilitate the trouble shooting process
- Describe the technical issues related to the Wide Area Networks and identify the common technologies available in establishing WAN infrastructure
- Describe the specific actions that can be taken to enforce network level security.

**3. Course Outlines:**

Specific Objectives	Contents
<ul style="list-style-type: none"><li>• Describe the basic concept of communications and the electronic implementation of communications paradigms</li><li>• Identify the characteristics and the analyze the signals properties</li><li>• Identify the data rate limits in channels based on the Nyquist's and Shannon's theorem</li><li>• Describe the parameters to measure the performance of channel</li></ul>	<b>Unit 1: Fundamentals of digital communications (5)</b> <ul style="list-style-type: none"><li>1.1. Introduction to digital communications: Definitions of terms, Signal propagation, Signal types (Sine waves, Square waves), Signal parameters (Amplitude, Frequency, Phase).</li><li>1.2. Channel effects on transmission: Attenuation, Effects of limited bandwidth, Delay distortion, Noise.</li><li>1.3. Data rate limits in channels: Nyquist's theorem, Shannon's theorem.</li><li>1.4. Performance of Channel: Bandwidth, Throughput, Latency, Jitter, Bit Error Rate (BER)</li></ul> <b>Practical Work</b> <ul style="list-style-type: none"><li>• Demonstrate Sine and Square waves generation and analysis using MATLAB</li></ul>
<ul style="list-style-type: none"><li>• Describe how digital data can be transmitted using analog transmission facilities.</li><li>• Map a binary pattern into a signal encoded using different encoding schemes</li><li>• Select a suitable transmission medium/media for the implementation of a</li></ul>	<b>Unit 2: Physical layer characterization (12)</b> <ul style="list-style-type: none"><li>2.1 Electromagnetic Spectrum for Communication and Type of Propagation</li><li>2.2 Guided Transmission Media: Twisted pair cables, Co-axial cables, Fibre optic cables</li><li>2.3. Unguided Transmission Media: Wireless media (Terrestrial Microwaves, Satellite Communication and Cellular System).</li><li>2.4. Physical Layer Interfaces: RS 232 / EIA 232/ USB.</li></ul>



<p>communication network</p> <ul style="list-style-type: none"> <li>Recognize the constraints related to the practical usage of transmission media</li> </ul>	<p><b>Practical Works:</b></p> <ul style="list-style-type: none"> <li>Physical demonstration and explanation of different transmission media and physical layer interfaces</li> </ul>
<ul style="list-style-type: none"> <li>Describe the design issues related to data transfer.</li> <li>Describe both analog and digital modulation techniques.</li> <li>Compare and contrast the circuit and packet switching technologies</li> <li>Describe the concept and the use of multiplexing technologies</li> <li>Describe error control mechanisms</li> </ul>	<p><b>Unit 3: Data transmission mechanisms (20)</b></p> <p>3.1. Communication modes: Simplex, Half-duplex, Full –duplex.</p> <p>3.2. Transmission modes: Serial transmission, Parallel transmission.</p> <p>3.3. Synchronization: Asynchronous transmission, Synchronous transmission.</p> <p>3.4. Modulation Techniques: Types of Analog Modulation (Amplitude Modulation, Frequency Modulation and Phase Modulation), Digital Modulation [Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Amplitude Modulation (QAM)]</p> <p>3.5. Introduction to packet switching: Circuit switching vs. packet switching, Connection oriented services (Virtual circuits), Connectionless services (Datagram), X.25, Frame Relay and ATM.</p> <p>3.6. Multiplexing: Frequency division multiplexing (FDM), Time division multiplexing (TDM), Wave division multiplexing (WDM).</p> <p>3.7. Error control methods: Feedback error recovery (ARQ) (Eg: Based on parity check), Forward error correction (FEC) (Eg: CRC)</p> <p><b>Practical Works:</b></p> <ul style="list-style-type: none"> <li>Demonstrate Analog Modulation Generation and Reconstruction using MATLAB</li> <li>Demonstrate Digital Modulation (ASK, FSK, PSK) Generation and Reconstruction using MATLAB</li> </ul>
<ul style="list-style-type: none"> <li>Describe the advantages of a layered architecture</li> <li>Illustrate the roles of each layer in the OSI &amp; TCP/ IP model two process and process communication.</li> <li>Provide a description of the emergence and the evolution of computer networks</li> <li>Discuss the selection of suitable geometric layout for a network based on the standard topologies</li> <li>Outline the features of different types of computer networks</li> </ul>	<p><b>Unit 4: Network architectures (8)</b></p> <p>4.1. Introduction to computer networks.</p> <p>4.2. Network topologies: Bus, Star, Ring.</p> <p>4.3. Types of networks: Local area networks, Wide Area Networks, Personal Area Networks.</p> <p>4.4. Layered network model: OSI model, TCP/ IP model.</p> <p><b>Practical Works</b></p> <ul style="list-style-type: none"> <li>Network wiring and LAN setup.</li> </ul>
<ul style="list-style-type: none"> <li>Give a description of the TCP/IP protocol suite</li> </ul>	<p><b>Unit 5: Internet protocols (14)</b></p> <p>5.1. Introduction: History of the Internet protocols,</p>

<p>including the roles of major protocols</p> <ul style="list-style-type: none"> <li>• Configure an IP address block into a given number of subnets.</li> <li>• Use the IP based diagnostic commands to support troubleshooting in IP networks.</li> <li>• Describe IP routing mechanisms</li> <li>• Describe the popular application layer protocols in the Internet</li> <li>• Recognize the limitations of IP version 4 and the advantages of IP version 6.</li> </ul>	<p>Internet protocol stack, IP Addressing and Routing (Version 4), Subnetting: Fixed and variable length, Uni-cast routing algorithms.</p> <p>5.2. Transport Layer protocols: TCP and UDP.</p> <p>5.3. IP Support Protocols: ARP, DHCP and ICMP</p> <p>5.4. Application Layer Protocols: Domain Name System (DNS), Email – SMTP, POP, IMAP, FTP, HTTP, RTP and VoIP.</p> <p>5.5. IP version 6.</p> <p><b>Practical Works:</b></p> <ul style="list-style-type: none"> <li>• Setup of Web Server, DNS Server, DHCP Server</li> </ul>
<ul style="list-style-type: none"> <li>• Compare and contrast different LAN technologies such as IEEE 802 LAN standards.</li> <li>• Describe the problem of channel allocation in the LAN segments and the solutions used.</li> <li>• Design a large Ethernet network using hubs and switches and to suggest the suitable devices to provide the connectivity to the other outside networks.</li> <li>• Describe the problems associated in deploying a wireless LAN and propose solutions.</li> </ul>	<p><b>Unit 6: Local area networks (14)</b></p> <p>6.1. Introduction to LANs.</p> <p>6.2. Conventional LAN Architectures: Access Protocols (CSMA/CD, Token Passing), Interconnecting devices (Hubs, L2 /L3 Switch)</p> <p>6.3. IEEE 802 MAC layer standards : 802.3, 802.11, 802.15 Switched Ethernet variants: Fast Ethernet, Gigabit Ethernet, 10Gb Ethernet.</p> <p>6.4. Wireless LANs (802.11): Access methods (CSMA/CA), Frequency Bands (ISM), Operating Modes (adhoc, Managed), Variants (802.11 a/ b/ g/ n), Wireless interconnection devices (Hub, Router).</p> <p>6.5 Bluetooth (802.15) wireless personal area network.</p> <p><b>Practical Works:</b></p> <ul style="list-style-type: none"> <li>• Router Basic Configuration</li> <li>• Static and Dynamic Routing</li> <li>• Router access-list configuration</li> </ul>
<ul style="list-style-type: none"> <li>• Identify the techniques of securing a private network</li> <li>• Describe issues in structured cabling</li> <li>• Identify connecting options made available by service providers</li> </ul>	<p><b>Unit 7: Practical aspects of networking (7)</b></p> <p>7.1. Structured cabling and specifications: Standards CAT5, 5E, CAT6 etc..</p> <p>7.2. Network security: Firewalls and NAT, VLANs, VPNs, Proxy servers, Wireless security.</p> <p>7.3. User access technologies: Wired (xDSL, FTTH), Cellular wireless (GPRS, EDGE, HSPDA), Broadband wireless (802.16)</p> <p><b>Practical Works:</b></p> <ul style="list-style-type: none"> <li>• Creating VLAN</li> </ul>

#### 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

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: Assignments on numerical related to Nyquist's and Shannon's theorem

Unit 2: Self-study and ask students to make presentation on examples of Terrestrial Microwaves, Satellite Communication and Cellular System.

Unit 3: Homework and Assignment on numerical related Modulation techniques

Unit 4: Homework and Assignment on Difference between OSI and TCP/IP model

Unit 5: Homework and Assignment on comparison of IP version 4 and IP version 6

Unit 6: Self-study and ask students to make detail report and presentation on IEEE 802 MAC layer standards: 802.3, 802.11, 802.15,

Unit 7: Self-study and ask students to make detail report and presentation on GPRS, EDGE, HSPDA

#### 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.

##### 5.1. Internal Evaluation (40 Points):

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

1) Class Attendance	5 points
2) Learning activities and class performance	5 points
3) First assignment (written assignment)	10 points
4) Second assignment (Case Study/project work with presentation )	10 points
5) Terminal Examination	10 Points
Total	40 Points

##### 5.2 Semester Examination (40 Points)

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

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

##### 5.3 External Practical Exam/Viva (20 Points):

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

#### 6. Recommended books and References materials (including relevant published articles in national and international journals)

**Recommended books:**

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

**References materials:**

Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, 4<sup>th</sup> Edition or available latest edition

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